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A PRELIMINARY REVIEW OF THE FAMILY GONOSTOMATIDAE, WITH A KEY TO THE GENERA AND THE DESCRIPTION OF A NEW SPECIES FROM THE TROPICAL PACIFIC

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No. 2 — *A Preliminary Review of the Family Gonostomatidae, with a Key to the Genera and the Description of a New Species from the Tropical Pacific.*

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In recent years collections made aboard the research vessel *Oregon* of the United States Fish and Wildlife Service, have yielded a number of species of the family Gonostomatidae. Among these were the first known western Atlantic specimens of the genera *Triplophos* and *Argyripnus;* a new maurolicid genus and species, *Sonoda megalophthalma* Grey (1959) ; new and well preserved material of *Yarrella blackfordi* Goode and Bean, and *Polymetme corythacola* (Alcock) ; and adult specimens of *Diplophos maderensis* (Johnson). A study of these specimens, preparatory to a revision of the family Gonostomatidae, has resulted in the following discoveries.

1. *Yarrella blackfordi* possesses serial photophores on the body other than the ventral and lateral rows described on the types, and therefore all species presently placed in the genus *Yarrella* Goode and Bean, except the type species, must be excluded from the genus.

2. *Lychnopoles* Garman is a synonym of *Yarrella.*

3. The genus *Polymetme* McCulloch, usually considered a synonym of *Yarrella,* is reinstated to include most of the species formerly placed in the latter.

4. *Yarrella mauli* Poll has been assigned to a new genus, *Pollichthys* (Grey, 1959).

5. *Manducus* Goode and Bean is reduced to the status of a subgenus of *Diplophos* Günther.

Other material studied has produced the following results.

1. *Photichthys nonsuchae* Beebe has been placed in a new genus, *Woodsia,* and a second specimen of this species has been described from the eastern Pacific (Grey, 1959).

2. *Snellius* Koumans is a synonym of *Margrethia* Jespersen and Tåning.

3. *Gonostoma atlanticum* Norman, which was first described as a subspecies of *G. denudatum* Rafinesque, is given specific rank.

4. A new species of the genus *Gonostoma* Günther is described from the Pacific, and new records of *G. gracile* Günther are listed.

5. New material of *Danaphos* Bruun from the eastern Pacific has shown that *D. asteroscopus* Bruun is probably a synonym of *D. oculatus* (Garman).

To the following people I would like to express my appreciation for the loan of specimens, or for information or advice. Dr. Frederick H. Berry, Dr. Henry B. Bigelow, Mr. Harvey R. Bullis Jr., Dr. Daniel M. Cohen, Mrs. Myvanwy Dick, Dr. Alfred W. Ebeling, Dr. Carl L. Hubbs, Dr. Einar Koefoed, Mr. G. E. Maul, Dr. Giles W. Mead, Dr. James E. Morrow Jr., Dr. George S. Myers (in particular), Dr. Max Poll, Dr. Andreas B. Rechnitzer, Prof. L. R. Richardson, Dr. C. Richard Robins, Dr. L. P. Schultz, Miss Margaret Storey, and Dr. D. W. Tucker.

I am indebted to Dr. Rainer Zangerl for a number of X-ray photographs, which made possible vertebral counts of most of the species studied, and to Miss Janet Wright for assistance in the preparation of Figure 3. Figure 1 was drawn by Mrs. Myvanwy Dick and Figure 2 by Mr. John Pfiffner, Staff Artist, Chicago Natural History Museum.

In spite of recent discoveries the inter-relationships of gonostomatid genera are still obscure, and a separation into subfamilies has not been attempted. The maurolicid genera certainly form a natural group but it seems unnatural and misleading to lump the remaining genera in a single subfamily, and I cannot see any advantage in introducing four or five new subfamilies at this time. Future discoveries may make such division possible, as the sea undoubtedly harbours undiscovered species, but undiscovered species are more likely to close the gaps between the known ones.

The maurolicid genera, given family rank by some and subfamily rank by most authors, are distinct from other gonostomatids in having many of the photophores grouped together and connected to a common gland, as well as in having fewer photophores on the branchiostegal membranes. Maurolicid fishes usually differ further in having smaller mouths, minute teeth in the jaws, and well developed pseudobranchiae, but there are exceptions. The pseudobranchiae of *Sonoda* and *Danaphos,* for

example, are small, fragile, and not always discernible; and furthermore two non-maurolicid genera, *Margrethia* and *Diplophos* (subgenus *Diplophos*), also possess pseudobranchiae. Maurolicid genera show more variation among themselves in some characters than do other groups of gonostomatid genera, especially in the relative positions of the dorsal, anal and ventral fins.

The four genera *Gonostoma, Cyclothone, Bonapartia* and *Margrethia* also form a natural group, distinguished principally by the absence of photophores on the isthmus; and the genus *Ichthyococcus* is so aberrant that there would be little or no objection to placing it alone in a separate subfamily. However, attempts to join the remaining genera into natural groups have not been entirely successful. *Diplophos, Triplophos* and *Yarrella* appear to be related, sharing such characters as numerous rows of photophores on the body, a tendency toward a long premaxillary, and the absence of an adipose fin; and *Photichthys, Woodsia, Vinciguerria* and *Pollichthys* can be grouped together in their possession of two suborbital photophores. But *Polymetme* cannot be placed in either of these groups. In general appearance it is much like *Photichthys* but the resemblance is relatively superficial. In its dentition and rather long premaxillary *Polymetme* approaches *Yarrella* but in the arrangement of the photophores, meristic characters, and the presence of an adipose fin it is similar to *Pollichthys. Polymetme* also has a tendency toward the elongation of some of the photophores, a character usually associated with the maurolicid genera. Some genera have one or two common characters although they do not seem to be otherwise closely related. For example, *Danaphos* and *Triplophos* are the only members of the family in which the dorsal origin is more than slightly in advance of the middle of the body length; and tubular eyes are found in *Ichthyococcus,* young *Vinciguerria, Valenciennellus,* and *Danaphos.*

Generic relationships have been tentatively arranged as shown in Figure 1. It is impossible to state which genus is the most primitive but it is possibly either *Diplophos* or *Yarrella.* Rechnitzer and Böhlke (1958, p. 15) have written of the evolutionary trend of the family Sternoptychidae (subfamilies Gonostomatinae, Maurolicinae, Sternoptychinae): ". . . the body becomes deep and foreshortened, with an enlarged head region and with

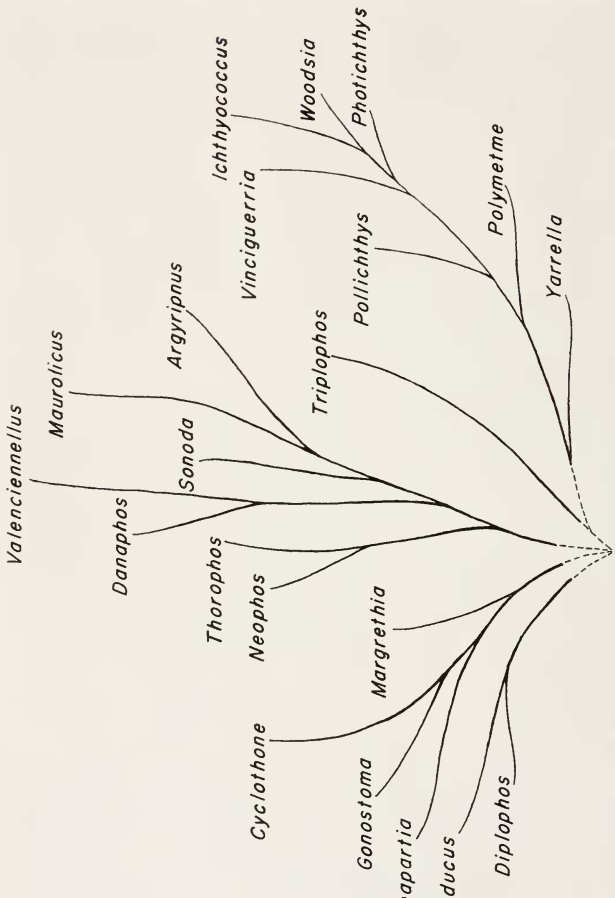

Figure 1. Diagram showing possible relationships of genera of the family Gonostomatidae.

a reduced number of segmental structures. The interruption of the anal photophores [i.e., their separation into groups] is in the same line of evolution, and the out-of-line arrangement of the anterior ventral photophores is an obvious specialization. An enlargement of the photophores, especially in the vertical axis, marks both the species [*Ichthyococcus*] sequence and the subfamily sequence." Such trends were demonstrated by these authors in the genus *Ichthyococcus,* with *elongatus* Imai the most primitive of three species and *irregularis* Rechnitzer and Böhlke the most advanced. A similar trend is evident within the genera *Diplophos* and *Yarrella* but on the whole the genera of the family Gonostomatidae, including maurolicids, cannot be fitted into such an evolutionary picture with any feeling of confidence. It is possible to trace a progression from *Diplophos* to *Ichthyococcus* through the following genera: *Yarrella* → *Polymetme* → *Pollichthys* → *Photichthys* → *Vinciguerria* → *Woodsia,* but in the remaining groups of genera there may be more than one line of evolution and these are obscure at best. *Gonostoma* and *Bonapartia* are obviously closely related, as are *Gonostoma* and *Cyclothone,* but *Margrethia,* which is the only short and deep-bodied member of this group, shows relationship to all three of the other genera without a strong resemblance to any of them. As for the maurolicid genera, even after disposing of *Argyripnus* as an aberrant offshoot, we are left with six genera which defy any kind of orderly arrangement from primitive to specialized or advanced except that *Maurolicus* does have a short, deep body and a relatively low vertebral count and could therefore possibly be considered the most specialized. And *Neophos,* having fewer of the photophores in groups, a large mouth, and an elongate body, is probably the most primitive (its vertebral count is not known). In Figure 1 the maurolicid genera have been placed near *Diplophos, Margrethia* and *Triplophos* for the following reasons.

1. According to Brauer (1908, p. 27) the photophore structure of *Triplophos* is very similar to that of maurolicids.

2. *Margrethia* is similar in several respects to maurolicids (pseudobranchiae present, some of the photophores elongated and close together) and there is further evidence also that maurolicids stem from something near the *Gonostoma-Margrethia*

group of genera. In both groups the distance between the ventral bases and the anal origin is short and the VAV count is correspondingly low (with the exception of the newly discovered *Gonostoma ebelingi,* which has 10 VAV and a rather long space between ventrals and anal). And in both there is a tendency toward a more anteriorly situated anus than in most other gonostomatids.

3. *Diplophos* and the maurolicid group show a possible common origin in the possession of pseudobranchiae (subgenus *Diplophos*) and in having the spines on the inner edge of the first gill arch absent or reduced to rudiments. These spines are well developed, even though usually short, in all other gonostomatids, and it may be significant that they are minute in *Ichthyococcus, Bonapartia* and *Margrethia.* It is also interesting to note that in some specimens of *Diplophos* (subgenus *Diplophos*) the rows of minute photophores found below the eye and along the lower jaw appear to be contained in a common black membrane, although I am unable to assert that this structure is similar to the connective membrane of the photophores of maurolicids.

Of the twenty genera included in the family Gonostomatidae at least nine are monotypic and it is sometimes difficult to judge whether differences between species are generic or specific. However, where several species of a genus are known the interspecific differences are usually slight and the existence of numerous genera seems to be natural. *Diplophos, Yarrella* and, especially, *Gonostoma* are exceptional in having more or less sharply differentiated species. A number of characters seem to be highly plastic throughout the family and even sometimes within a genus. There are also areas of stability but these are notable for their exceptions, as can be seen by the following examples.

1. Until recently all described maurolicid genera had only 4-6 VAV photophores; and no known species of *Gonostoma* had more than 5. However, the recently described maurolicid, *Sonoda megalophthalma,* has a VAV count of 7-8; and the newly discovered *Gonostoma ebelingi* has 10 VAV photophores.

2. In all genera except some maurolicids and *Ichthyococcus* the ventral fins are inserted in advance of the dorsal origin. They are behind the first dorsal ray in *Ichthyococcus* and are variable

in position in maurolicid genera (behind the dorsal origin in *Danaphos,* well ahead of it in *Neophos, Thorophos, Valenciennellus* and *Sonoda,* and close to a vertical from the first dorsal ray in *Argyripnus* and *Maurolicus*).

3. The dorsal origin in non-maurolicid genera is in advance of the anal origin in all but *Gonostoma, Cyclothone* and *Bonapartia.* In these three genera either the dorsal and anal origins are opposite one another or the anal is farther forward, but in *Margrethia,* the fourth member of this group, the dorsal origin is always slightly in front of the anal origin. In maurolicid genera, again, the relative positions of these fins is variable (dorsal origin anterior to anal origin in *Argyripnus, Danaphos* and *Maurolicus,* opposite or behind it in *Sonoda, Valenciennellus, Thorophos* and *Neophos*).

4. The presence or absence of an adipose fin is a reliable generic character except in *Gonostoma,* in which this fin is present in all but two species, *atlanticum* and *gracile.* It is also very small and difficult to distinguish in several maurolicid genera.

5. In general the anus is situated close to the origin of the anal fin in non-maurolicid genera and more remote from it in maurolicids. Again there are exceptions, for the anus is situated well in advance of the anal origin in the genus *Cyclothone* and in two species of *Gonostoma* (*ebelingi, gracile*); and it is near the anal fin in three maurolicid genera (*Neophos, Valenciennellus, Maurolicus*).

6. The mouth is large and oblique in all non-maurolicid genera excepting *Ichthyococcus,* in which it is relatively small. Three maurolicids also have large, oblique mouths (*Neophos, Thorophos, Argyripnus*) but in *Danaphos, Valenciennellus, Sonoda* and *Maurolicus* the mouth is relatively small and the gape very oblique or almost vertical.

7. The extent to which the premaxillary enters the gape varies in the extreme, being excluded from it in *Ichthyococcus* and forming virtually all of it in *Triplophos.* In maurolicid genera the premaxillary is always at least half as long as the toothed portion of the maxillary and is usually more than half as long. The premaxillary of *Diplophos* and *Yarrella* is equal to or longer than the toothed portion of the maxillary; in *Polymetme* it is only slightly shorter; in *Pollichthys, Photichthys* and *Woodsia*

it is about half, or more than half as long; and in *Vinciguerria, Bonapartia, Margrethia, Gonostoma* and *Cyclothone* it is less than half as long.

8. The premaxillary teeth are uniserial in all gonostomatids excepting *Yarrella, Triplophos* and *Polymetme,* in which they are in two rows, and *Neophos,* in which they are arranged irregularly. Maxillary teeth are always uniserial as far as known, although in some species one or two of the most posterior maxillary teeth may be situated higher than the remainder. The lower jaw teeth also are mostly in a single row except anteriorly, where there is usually a very short outer row of teeth. However, in some genera the teeth on the mandible are biserial for almost its full length (*Yarrella, Triplophos, Polymetme, Argyripnus*), or for about half its length (*Vinciguerria, Sonoda*); and in *Ichthyococcus,* probably *Valenciennellus,* and sometimes *Maurolicus,* they are entirely uniserial and lack the anterior outer row. The mandibular teeth of *Danaphos* are irregular anteriorly and uniserial posteriorly.

9. Teeth on the vomer, palatines, pterygoids and tongue, when present, are usually small or even minute, although *Gonostoma bathyphilum* has a few much enlarged pterygoid teeth posteriorly. *Cyclothone* may have as many as five or six small, close-set teeth in a lengthwise row on each side of the vomer (absent in at least one species), and in this genus the palatine and pterygoid teeth are present only on the anterior ends of the bones, in small clusters. Other genera have fewer vomerine teeth in crosswise rows (or none); the palatine teeth, if present, are linear; and the pterygoid teeth, if present, are arranged in more or less circular patches of minute teeth with sometimes an irregular, sparse row posteriorly. *Maurolicus* sometimes has a few pterygoid teeth but these are apparently lacking in all other maurolicid genera. Only three non-maurolicid genera lack pterygoid teeth (*Ichthyococcus, Vinciguerria, Woodsia*) but they are sometimes absent also in *Diplophos* (subgenus *Diplophos*), *Triplophos, Pollichthys* and *Photichthys;* and are microscopic in *Yarrella,* if present at all. Teeth have been found on the tongue only in *Diplophos* (sometimes), *Pollichthys, Photichthys* (sometimes), *Bonapartia, Margrethia,* and in two species of *Gonostoma* (*denudatum, atlanticum* rarely).

10. Meristic characters are shown in Table 6.

The key on page 69 has been based on all known genera except *Thorophos* Bruun, of which no specimens have been seen; nor have I seen any Indian or Pacific Ocean material of *Triplophos*, *Polymetme*, *Vinciguerria*, *Ichthyococcus*, *Margrethia*, *Argyripnus* or *Valenciennellus*. It should be emphasized also that the genus *Cyclothone* has not yet been studied in detail. The following hitherto unreported material has been examined but is not pertinent to the present publication except as it applies to the characters contained in the key to the genera.

Photichthys argenteus Hutton. Three specimens, standard length 100-118 mm., off Cape Palliser, Cook Strait, New Zealand, 1942, from the stomach of a groper caught in 40-50 fathoms (73-91 meters). Received from Prof. L. R. Richardson, Victoria University College, Wellington, New Zealand. The genus *Photichthys* is defined on page 100.

Ichthyococcus Bonaparte. Only a few small specimens of *I. ovatus* (Cocco) are available for study (Grey, 1955, p. 273). Included in this lot are three hitherto unrecorded metamorphosing specimens. The premaxillary bones are very difficult to distinguish on specimens of *I. ovatus* but a communication received from Dr. A. B. Rechnitzer (1958, *in litt.*) has confirmed the impression that the premaxillary is excluded from the gape. Dr. Rechnitzer also found it difficult to distinguish these bones on two eastern Atlantic specimens of *I. ovatus*, but an examination of three larger specimens of *I. elongatus* Imai revealed that the premaxillary terminates at the apex of the inverted V-shaped symphysis of the upper jaw; and that the maxillary is continuous throughout the gape and is toothed, or serrated, along its entire edge.

Gonostoma Rafinesque 1810. A few unrecorded western Atlantic specimens of *G. elongatum* Günther 1878 and *G. bathyphilum* (Vaillant) 1888, from the collection of the United States National Museum, have been examined, as well as new material of *G. elongatum* from the Gulf of Mexico, the Caribbean Sea, and off northern South America (*Oregon*). The genus is defined on page 102, new material of *G. atlanticum* Norman from both the Atlantic and Pacific oceans is described on page 106,

and a new species, *G. ebelingi*, from the tropical Pacific, is described on page 109. I have also seen two Mediterranean specimens of *G. denudatum* Rafinesque 1810, loaned by the Museum of Comparative Zoology, and the following unrecorded specimens of *G. gracile* Günther 1878, most of them loaned by Scripps Institution of Oceanography. The latter show that *G. gracile* has a wide distribution in the northern and western Pacific.

Western Pacific: Five, standard length 60-110 mm., C.N.H.M. No. 42780, taken during the *Albatross* Philippine cruise off Hong Kong, China, 6 November 1908; eleven, standard length 40-119 mm., SIO No. H 53-367, Kii Strait, Japan, 23-24 October 1952, 10′ midwater trawl, depth not known; one, standard length 95 mm., SIO No. H 51-371, Japan Trench, 32° 08′ N., 142° 04′ E., 26 October 1953, *S. F. Baird*, 10′ midwater trawl, 0-4455 fathoms (0-8147 meters); five, standard length 71-121 mm., SIO No. H 53-356, off Honshu, Japan, 35° 01.8′ N., 145° 12′ E. to 34° 48.5′ N., 145° 05.4′ E., 1 October 1953, *S. F. Baird*, 10′ midwater trawl, 1000 fathoms (1829 meters).

North and middle Pacific: Three, standard length 69-87 mm., SIO No. H 53-335, southeast of Kamchatka, 51° 09.5′ N., 164° 32.6′ E. to 50° 59.3′ N., 164° 27.1′ E., 4 September 1953, *S. F. Baird*, 10′ midwater trawl, 0-580 fathoms (0-1061 meters); one, standard length *ca.* 83 mm., SIO No. H 53-344, off the Kurile Islands, 45° 29.7′ N., 154° 20′ E. to 45° 18.8′ N., 154° 02.6′ E., 16 September 1953, *S. F. Baird*, 10′ midwater trawl, 0-2600 fathoms (0-4755 meters); one, standard length *ca.* 92 mm., SIO No. H 53-371, 48° 58.3′–37.4′ N., 157° 49.8′–29′ W., 5-6 September 1951, *Horizon*, 10′ midwater trawl, 2200-2400 fathoms (4023-4389 meters); four, standard length 105-116 mm., SIO No. H 51-374, 37° 29′–01.5′ N., 154° 03.5′–153° 58.2′ W., 12-13 September 1951, *Horizon*, 10′ midwater trawl, 700 fathoms (1280 meters); three, standard length 96.5-111.5 mm., SIO No. H 51-360, 43° 08′ N., 150° W., 13 August 1951, 10′ midwater trawl, 35-175 meters; three, standard length 102-120 mm., SIO No. H 51-375, 31° 54.3′ N., 152° 21.6′ W. to 31° 36.5′ N., 152° 03.6′ W., 15 September 1951, *Horizon*, 10′ midwater trawl, 1790 fathoms (3274 meters); one, standard length 96 mm., SIO No. H 53-312, 44° 59′ N., 148° 46.5′ W., 4 August 1953, *S. F. Baird*, 1 meter plankton net, 0-1000 fathoms (0-1829 meters); five, standard

length 107-130 mm., SIO No. II 51-358, 40° 35′ N., 147° 55′ W., 10 August 1951, *Horizon*, 10′ midwater trawl, 350-600 meters; one, standard length 116.5 mm., SIO No. II 53-308, 39° 23′ N., 142° 51′ W. to 39° 15.5′ N., 142° 54.9′ W., 1 August 1953, *S. F. Baird*, diving dredge No. 1 (no depth).

Bonapartia pedaliota Goode and Bean 1895. One specimen, standard length 42 mm., U.S.N.M. No. 108303, *Caroline*, Virgin Islands, 18° 44′ N., 65° 15′ 15″ W., 26 February 1933, 600 fathoms (1097 meters).

Margrethia Jespersen and Tåning 1919. Koumans (1953, p. 183) was apparently unaware of the description of the genus *Margrethia* when he proposed the genus *Snellius*, which is an obvious synonym of *Margrethia*.

Argyripnus atlanticus Maul 1952. One specimen, standard length 67 mm., *Oregon*, September 1957, Caribbean Sea, further data lost. The type of *atlanticus* was described and figured as having four OP and was said to differ from *ephippiatus* Gilbert and Cramer 1896 and *iridescens* McCulloch 1926 in having a much larger posterior opercular organ. Both Pacific species were also described as having two photophores in this area: ". . . one above the other and separated by a black, metallic-hued space" (McCulloch, 1926, p. 170); ". . . one above the other, at the two ends of a short vertical steel-blue band . . ." (Gilbert and Cramer, 1896, p. 415). In the specimen examined the opercular organ has the outward appearance of a single, greatly elongated and enlarged one encased in a deep black sheath, with a luminous area exposed near the top. Actually there probably are two organs involved, but they are at least encased in a common sheath, and the structure is similar in all species, as can be seen in the published figures.

Danaphos Bruun 1931. The genus is defined on page 112 from new material in the collection of Scripps Institution of Oceanography.

Neophos Myers 1932. The type has been examined and the genus is defined on page 114.

Valenciennellus tripunctulatus (Esmark) 1870. One specimen, 30.5 mm., Stanford University No. 18713, *Oregon* Station 841, Gulf of Mexico, 25° 58′ N., 88° 00′ W., 6 October 1953, 830-930 fathoms (1518-1700 meters), reported as *Maurolicus mülleri*

by Springer and Bullis (1956). The genus *Valenciennellus* Jordan and Evermann contains two, and possibly three species. *V. tripunctulatus*, of which *V. stellatus* Garman 1899 is possibly a synonym, is cosmopolitan in tropical and subtropical waters. *V. carlsbergi* Bruun 1931 has been found only in the tropical Indo-Malayan area. The latter differs from *tripunctulatus* in having a shorter and deeper caudal peduncle, only two OA photophores, and only three groups of AC photophores (a group of three above the tenth to twelfth anal rays, a group of two above the middle of the anal fin, and a group of four on the caudal peduncle).

V. stellatus was distinguished by Garman (1899, p. 239) from *V. tripunctulatus* by two characters, a shorter dorsal fin and a smaller number of AC photophore groups. Actually, however, the dorsal count of *stellatus* is higher, numbering twelve rays instead of the seven to ten of *tripunctulatus*. Garman's conclusion that the dorsal fins of the two species differed was based on an error in the figure published by Lütken (1892, pl. 1, fig. 6). This figure shows a long dorsal fin of about seventeen rays although in the text Lütken gave the dorsal count as nine or ten rays. The error in the figure probably resulted from the artist having drawn the dorsal and the adipose as a continuous fin. Garman's second distinction, the presence of only four groups of AC photophores, may be valid. There is, however, variation in the number of AC groups in *tripunctulatus*, although five is the typical number. Only examination of a series of specimens from the eastern Pacific will show with certainty whether or not *stellatus* is a distinct species with a constantly higher number of dorsal rays and a lower number of AC photophores.

It should be noted that Jespersen's description (1933) of the photophores of *V. tripunctulatus* is misleading in part. His OA count of 10 includes the second IV group of (4) and the lower posterior OP. His "series of 4 organs underneath the cheek" refers to the BR (six in Jespersen's figure), which are visible beneath the transparent jaw bones in most specimens. Finally, the "two or three on the branchiostegal membrane" must refer to the first IV group of (3) on the isthmus.

Maurolicus muelleri (Gmelin) 1789. A few unreported specimens from the collection of the United States National Museum

have been examined, four of them washed ashore on the Massachusetts coast and two found on the beach at Juan Fernandez in the southeastern Pacific.

In the key, and in descriptions, the following symbols are used to represent the photophores: ORB, those situated close to the eye; OP, opercular photophores; SO, a pair often found near the symphysis of the lower jaw; BR, organs on the branchiostegal membranes; IV, pre-ventral photophores of the ventral series; VAV, those of the ventral series found between the ventral bases and the anal origin; AC, photophores of the ventral series posterior to the anal origin; IC, total number in the ventral series, from tip of isthmus to base of caudal; OA, photophores of the lateral series. Photophore counts in parentheses indicate that these organs are grouped in a common gland.

Key to the Genera and Subgenera of the Family Gonostomatidae

1a. BR 8 or more (reduced in size and number in *Cyclothone obscura*, obscure and very small in *Gonostoma bathyphilum*). Serial photophores separate, not grouped in common glands.

2a. Photophores present on isthmus. IV 20 or more. IC 42 or more. [Dorsal origin always in advance of anal origin. Body always with at least two rows of serial photophores].

3a. More than two rows of photophores on body, those above the IC and OA frequently mostly or entirely lost with the skin. No adipose fin. OA 40 or more. [ORB 1, close to front of eye or below it].

4a. Teeth of upper jaw all uniserial. Teeth of lower jaw uniserial except for a short outer row anteriorly. On posterior half of lower jaw a row of minute photophores in adult, preceded by a somewhat larger photophore. Lateral line area with a row of small photophores extending on to caudal fin (often partially lost). Gill rakers on lower limb of first arch 7-9. Vertebrae 63 to *ca.* 85 (and more?).

Diplophos Günther 1873
Atlantic, Pacific, Indian

5a. Dorsal origin about in middle of body, usually slightly nearer tip of snout than caudal base. Head and trunk approximately same length as tail, distance between snout and anal origin *ca.* 47.5-51.2%, and between anal origin and caudal base *ca.* 48.0-53.0% of standard length. Depth 8.2-12.3% of standard length. Anal rays (43?) 53-68. IV 40-49. AC 43-49. IC 97-113. OA 66-87. Lateral line *ca.* 80-98. Vertebrae *ca.* 85 (and more?).

subgenus *Diplophos* Günther 1873
Atlantic, Pacific, Indian

5b. Dorsal origin slightly behind middle of body (close to middle in young). Head and trunk longer than tail (proportionately less so in young), distance between snout and anal origin 59.0-63.0%, and between anal origin and caudal base 36.5-41.2% of standard length. Depth *ca.* 15-17% of standard length. Anal rays 36-41. IV 30-32. AC 28-30. IC 70-75. OA 44-48. Lateral line 63-68. Vertebrae 63.

subgenus *Manducus* Goode and Bean 1895
Atlantic

4b. Teeth of premaxillary biserial. Teeth of lower jaw biserial on most of its length. No photophores on posterior half of lower jaw. Lateral line area not marked by a row of photophores. Gill rakers on lower limb of first arch 12-16. Vertebrae 45 to *ca.* 60(?).

6a. Trunk much shorter than tail. Dorsal origin far in advance of middle of body length. Toothed portion of maxillary very short, scarcely entering gape. Snout shorter than eye. Dorsal 10-12, anal 54-63. VAV 5-7. AC 35-41. Head with additional photophores above upper jaw. Vertebrae *ca.* 60?

Triplophos Brauer 1902
Atlantic, Indian

6b. Trunk slightly longer than tail. Dorsal origin about in middle of body length or slightly behind it. Toothed portion of maxillary entering gape. Snout longer than eye. Dorsal 14-16, anal 26-31. VAV 9-12. AC 20-27. Photophores on upper part of head consisting only of the ORB and OP. Vertebrae 45-54.

Yarrella Goode and Bean 1895
Atlantic, Pacific

3b. Body with only two rows of photophores. Adipose fin present. OA 16-34.

7a. ORB 1, close to front of eye. Premaxillary teeth biserial. AC 22-25. [Vertebrae 45].

Polymetme McCulloch 1926
Atlantic, Pacific, Indian

7b. ORB 2, one close to front of eye, one close to its hind margin or below center (*Ichthyococcus*). Teeth of upper jaw all uniserial. AC 12-21.

8a. Eye normal (except somewhat tubular in some juvenile *Vinciguerria*). Mouth large, bordered by premaxillary anteriorly. Jaws equal, or lower jaw projecting slightly beyond upper jaw anteriorly. Teeth relatively well developed. Ventral fins in advance of dorsal origin. Gill rakers minutely denticulate on inner edge.

9a. Anal origin beneath dorsal or close behind a vertical from its last ray. Branchiostegal rays 9-13. BR 8-9 (12?). OA 19-25.

10a. Anal origin beneath middle or anterior portion of dorsal. Anal 22-30. Anterior ORB larger than posterior one. AC 19-21. Vertebrae *ca.* 40?

Pollichthys Grey 1959
Atlantic, Pacific

10b. Anal origin beneath middle or end of dorsal. Anal 12-16. ORB equal in size or posterior one larger. AC 12-16. Vertebrae (36?) 38-42.

Vinciguerria Jordan and Evermann 1895
Atlantic, Pacific, Indian

9b. Anal origin well behind end of dorsal fin. Branchiostegal rays 17-21. BR 14-18. OA 29-34.

11a. Gill rakers normally developed, 11 + 4-5 on first arch. Premaxillary about half as long as toothed portion of maxillary. Body elongate, depth *ca.* 6-6.5 times in standard length. Anal 23-26. VAV 15-17. AC 16-18. OA 33-34, ending above anterior portion of anal fin. Vertebrae 51.

Photichthys Hutton 1872
Atlantic, Pacific

11b. Only 3-4 normally developed gill rakers at angle of first arch. Premaxillary more than half as long as toothed portion of maxillary. Body not elongate, depth *ca.* 5 times in standard length. Anal 14. VAV 11-12. AC 12. OA 29-31, ending above end of anal fin. Vertebrae? (myomeres *ca.* 45).

Woodsia Grey 1959
Atlantic, Pacific

8b. Eye tubular. Mouth small. Premaxillary not entering into gape. Lower jaw included anteriorly. Teeth minute. Ventral fins behind dorsal origin. Gill rakers short and smooth. [Anal origin well behind end of dorsal. Dorsal 10-15, anal 13-17. Branchiostegal rays 11-12. Lateral line 34-42. ORB 2. BR 11-12. IV 25-28. VAV 9-14. AC 12-14. OA 23-31. Vertebrae 38-47].

Ichthyococcus Bonaparte 1841
Atlantic, Pacific, Indian

2b. No photophores on isthmus. IV 17 or less. IC 26-43. [Premaxillary less than half as long as toothed portion of maxillary].

12a. Dorsal origin opposite or behind anal origin. No pseudobranchiae. SO present or absent.

13a. Body with at least two rows of photophores *or* photophores inconspicuous *or* obsolete. Dorsal 10-17. Pectoral 7-13. Adipose fin present or absent. Luminous glands usually present on procumbent caudal rays.

14a. Maxillary with a series of relatively long, slender teeth, and subequal, short teeth in the interspaces between them. Each palatine with a single row of teeth. Pterygoid teeth in a patch on each side anteriorly, these teeth small or minute; and a few teeth posteriorly, these sometimes enlarged. Vomer usually with one or two small teeth on each side, sometimes absent. Adipose fin present or absent. Anal rays 21-31. OA 11-21. SO present (except usually absent in *bathyphilum*). Vertebrae 37-40.

Gonostoma Rafinesque 1810
Atlantic, Pacific, Indian

14b. Maxillary teeth subequal, close-set, more or less increasing in size posteriorly, sometimes a few of them moderately enlarged. Palatine and pterygoid teeth usually present

anteriorly only, each in a small group of a few relatively prominent teeth; posterior pterygoid teeth, if present, microscopic. Vomer usually with a double row of several small, close-set teeth (absent, microscopic, or reduced to one or two in *braueri*, *alba* and *signata*). Adipose fin normally absent. Anal rays 16-21. OA 6-10. SO absent. Vertebrae 29-33.

Cyclothone Goode and Bean 1883
Atlantic, Pacific, Indian, Antarctic

13b. Body with a single row of conspicuous photophores. Dorsal 17-20. Pectoral 14-16. No adipose fin. No luminous glands on procumbent caudal rays. [SO present. Vertebrae 37].

Bonapartia Goode and Bean 1895
Atlantic

12b. Dorsal origin slightly in advance of anal origin. Pseudobranchiae present. SO absent. [Body with only one row of large, conspicuous, somewhat irregular photophores. Adipose fin present. Vertebrae 34].

Margrethia Jespersen and Tåning 1919
Atlantic, Pacific

1b. BR (6) or less (7 on one side of one specimen of *Sonoda*), conspicuous. At least some of the serial photophores grouped together in common glands appearing as black or silvery bands. [Photophores present on isthmus].

15a. AC composed largely of separate organs, more or less evenly spaced.

16a. Dorsal origin about in middle of body length, and a little behind anal origin. Ventral bases well ahead of dorsal origin. Eye normal. Dorsal 8-11. Anal 31-38. SO present.

17a. Photophores on isthmus, and VAV, in more than one group. AC 12-13, all single. OA 1. Dorsal 8. Anal 38. No adipose fin. Number of vertebrae unknown.

Neophos Myers 1932
Pacific

17b. Photophores on isthmus, and VAV, each in a single group. AC 14-15, mostly single but with a group of two anteriorly and another group of two just behind anal fin. OA 7. Dorsal 11. Anal 31. Adipose fin present. Number of vertebrae unknown.

Thorophos Bruun 1931
Pacific

16b. Dorsal origin well ahead of middle of body length and ahead of anal origin, which is behind end of dorsal fin. Ventral bases behind dorsal origin. Eye tubular. Dorsal 6. Anal 24-25. SO absent. [AC mostly single and rather widely and evenly spaced but with the first three in a group and a group of four on the peduncle, followed by a single organ. Vertebrae 38].

Danaphos Bruun 1931
Pacific, Indian

15b. AC composed of two to five groups of two or more organs each.

18a. Photophores between ventral and anal fins grouped separately from those above anterior portion of anal fin, the VAV straight and numbering 4-8.

19a. Dorsal origin about in middle of body length. Anal origin beneath or slightly in advance of dorsal origin. Ventral bases well ahead of dorsal origin. Trunk shorter than tail. SO absent. OA 7 or less.

20a. AC in three to six well separated groups of only two to four organs each. IV 20-24. VAV 4-5. AC 9-15. IC 36-40. Adipose fin present. Eye sometimes slightly tubular. Vertebrae 32-33?

Valenciennellus Jordan and Evermann 1895
Atlantic, Pacific, Indian

20b. AC in two subequal groups, each with sixteen organs or more. IV 16. VAV 7-8. AC 36-42. IC 58-66. No adipose fin. Eye normal. Vertebrae 40.

Sonoda Grey 1959
Atlantic

19b. Dorsal origin behind middle of body length. Anal origin behind dorsal origin. Ventral bases close to a vertical from first dorsal ray. Trunk longer than tail. SO present. OA 9. [AC in two long groups, preceded by a single elevated organ. Adipose fin present. Eye normal. Vertebrae 32-33].

Maurolicus Cocco 1838
Atlantic, Pacific, Indian

18b. Photophores between ventral and anal fins continuous with those above anterior portion of anal fin, this group rather sinuous and numbering 19-28, followed on the tail by one group of 5 and a second group of 12-18 organs. [Dorsal origin in advance of

anal origin. Ventral bases close to a vertical from first dorsal ray. Eye normal. SO absent. IC 53-67. Vertebrae 47].

Argyripnus Gilbert and Cramer 1896
Atlantic, Pacific

Diplophos Günther 1873

Diplophos Günther, 1873, Jour. Mus. Godeffroy, **2:** 101, type species *Diplophos taenia* Günther 1873, Atlantic, 22° N., 30° W. and 30° S., 24° W.; 1889, Rep. Sci. Res. Voy. Challenger, Zool., **31:** 32; Goode and Bean, 1895, Ocean. Ichth., p. 104; Barnard, 1925, Ann. So. Afr. Mus., **21:** 148; Norman, 1930, Discovery Rep., **2:** 295; Parr, 1931, Bull. Bingham Oceanogr. Coll., **2,** (4): 11 (part, *Lychnopoles* in synonymy); Fowler, 1936, Bull. Amer. Mus. Nat. Hist., **70:** 235; Matsubara, 1940, Suisan Kenkiu-shi, **35:** 319; Smith, 1949, Sea Fishes So. Afr., p. 105.

Manducus Goode and Bean, 1895, Ocean. Ichth., p. 514, type species *Gonostoma maderense* Johnson 1890, Madeira; Norman, 1930, Discovery Rep., **2:** 293 (part, *Lychnopoles* in synonymy); Fowler, 1936, Bull. Amer. Mus. Nat. Hist., **70:** 221, 1202 (part, *Lychnopoles* in synonymy).

Paraphotichthys Whitley, 1931, Australian Zool., **6:** 334, *Manducus* considered preoccupied by *Manduca* Huebner, *ca.* 1806, Lepidoptera.

Generic characters. Eye normal, moderate. Snout longer than orbit. Interorbital width at center of eye about equal to, or slightly greater than, diameter of orbit. Mouth large, oblique; edge of premaxillary straight; toothed edge of maxillary slightly convex; maxillary nearly reaching preopercle. Premaxillary almost, or quite as long as toothed edge of maxillary. Angle of preopercle slightly acute or nearly vertical. Teeth of upper jaw uniserial, unequal. Teeth of lower jaw unequal, uniserial except for a short outer row anteriorly. Vomer toothless or with 1-5 teeth on each side. Palatines each with a row of small teeth. Pterygoids with or without a patch of minute teeth on each side. Tongue with or without teeth. Gill rakers 7-9 + 3-5 = 10-14 on first arch. Spines on inner edge of first gill arch rudimentary or absent. Pseudobranchiae present or absent. Anus close to anal fin. Relative proportions of head and trunk to tail variable. Origin of dorsal fin near middle of body length, sometimes slightly before or slightly behind it. Origin of anal fin beneath end of dorsal fin or slightly behind last dorsal ray. Ventral bases in advance of dorsal origin. No adipose fin. ORB 1, below front

margin of eye. OP 3, upper one about level with center of eye, lower two level with end of maxillary. Additional photophores present on head above maxillary, in a row along posterior portion of lower jaw (the first of these larger), and lower surface of symphysis of lower jaw (2-4 minute, round spots, perhaps photophores). SO present, somewhat behind symphysis, hidden by lower jaw. BR 8-16. Body with ventral and lateral rows of photophores typical of family and also several rows above these; photophores present on isthmus. IV 30-49. VAV 12-17. AC 28-49, straight. IC 70-113. OA 45-87. Always a third row of photophores along lateral line from upper edge of gill opening to caudal fin, 65-98 organs, last one or two on caudal fin. Older specimens with additional serial rows of photophores above and below lateral line, and 1-3 photophores on or before pectoral base between ventral and lateral series. A pair of narrow strips of pale tissue, probably luminous, on ventral surface of body below eighth to seventeenth IV photophores. Fin rays: dorsal 9-13, anal 36-68, pectoral 8-11, ventral 7-8. Branchiostegal rays 11-14 (15-16?), bases prominent but without spines. Vertebrae 63 to *ca.* 85, or more.

Remarks. Diplophos is probably related to both *Yarrella* and *Gonostoma*. Its affinities with the former are set forth in the key to the genera on page 70, and in addition these two genera have a relatively long premaxillary. The relationship of *Diplophos* to *Gonostoma* is less obvious, but their common origin is possibly indicated by the similarity of their dentition and of their photophore structure (Brauer, 1908, p. 18), as well as in their tendency toward the development of luminous tissue on head and body. *Diplophos* may also be distantly related to the maurolicid group of genera (see p. 61).

Manducus Goode and Bean 1895 is reduced to the rank of subgenus because the distinction between this genus and *Diplophos* is of noticeably different value than distinctions between other gonostomatid genera and the differences appear to be of a specific rather than a generic nature, as shown in the key on page 70. However, *Diplophos, sensu stricto,* probably contains two or more closely related species that differ rather sharply from *maderensis*, the only known species of *Manducus*, and the latter name is therefore retained as a subgenus of *Diplophos*.

Subgenus DIPLOPHOS Günther 1873

In the following characters the subgenus *Diplophos* differs from the subgenus *Manducus* (cf. p. 81).

Angle of preopercle nearly vertical or slightly rounded. Pseudobranchiae sometimes present. Gill rakers 7-9 + 3 on first arch. Premaxillary about the same length as, or slightly shorter than, toothed portion of maxillary. Head and trunk about the same length as tail or slightly shorter. Origin of dorsal fin about in middle of body length but as far as known always slightly nearer tip of snout than caudal base. Origin of anal fin beneath end of dorsal fin or just behind its last ray. Ventral bases noticeably in front of dorsal origin. Photophores on upper part of head, in addition to the ORB and OP, consisting of one, level with ORB, on cheek above middle of maxillary; a row of 9-13 minute organs on cheek below eye, hidden beneath subocular bone; 2-4 small organs beneath posterior end of maxillary; small photophores also sometimes present on opercle above lower posterior OP and between the two lower OP. Area just below symphysis of lower jaw with two small round spots (photophores?) on each side. A row of 12-16 minute photophores on posterior portion of lower jaw, the first one enlarged. Patches of luminous tissue sometimes present on opercle, maxillary and tongue. BR 10-12 + 0-3. IV 40-49. VAV 13-17. AC 43-49, last two or three usually, but not always, slightly separated from the rest. IC 97-113. OA 66-87, sometimes ending above middle of anal fin, sometimes reaching caudal base. Lateral line row (80?) 86-98. A pair of narrow strips of pale tissue, probably luminous, below ninth to seventeenth IV photophores. Anal rays (43?) 53-68. Vertebrae *ca.* 85 (one eastern Pacific specimen).

It is impossible to determine the number of species contained in the *D. taenia* complex without examining a large series of specimens from different areas. Variation in fin ray and photophore counts is rather wide but specimens are too rare to determine the significance of these variations. The photophores of the ventral series are consistently fewer in Pacific specimens. Atlantic specimens are all in pretty good agreement with one another but even here there is enough variation, especially in the number of anal rays, to allow the possibility at least of subspecific differences. All Atlantic specimens are considered here

to belong to a single species, *D. taenia* Günther. The small specimen reported by Brauer (1906, p. 89) from the Indian Ocean agrees with Atlantic specimens. Norman (1939, p. 19) also reported, as *taenia,* two small specimens from the Indian Ocean. They were not described.

Brauer (1906, p. 90) described the BR as follows: "15-16 between the branchiostegal rays, the twelfth smaller and the last three smaller and separated by a large interspace from the others and from one another." No trace of these smaller organs has been found on Atlantic specimens examined but one to three are present on several eastern Pacific specimens. The description quoted suggests that the first 11-12 BR are analagous with the 11-12 of most of the specimens examined.

Diplophos taenia Günther 1873
Atlantic specimens

In the Atlantic, *D. taenia* has been reported from various localities between about 40° N. and 30° S.; and in the Indian Ocean off Natal, between the Seychelles and Zanzibar, and in the Arabian Sea. Counts and proportions of some Atlantic specimens are shown in Table 1. Included are two hitherto unreported specimens, U.S.N.M. Nos. 100525 and 100616, caught in 1914, at *Grampus* (*Bache*) Station 10182, off Bermuda, 30° 27′ N., 66° 05′ W., 19 February, surface; and Station 10196, northeast Providence Channel, Bahamas, 25° 27′ N., 77° 16′ W., 3 March, surface.

Both of these specimens are small, their standard lengths being 74 and 66 mm. No pseudobranchiae are visible. There are a few minute teeth on each side of the vomer in the larger specimen but none can be seen in the smaller one. Both have a single row of 6-9 small teeth on each palatine and there are no teeth on either the pterygoids or the tongue. A pair of thread-like strips of luminous(?) tissue is present on the ventral surface of the body below the fourteenth to seventeenth IV photophores. The OA number 71 and 73 and extend to a vertical from the middle of the anal fin; the organs decrease in size posteriorly. In addition to the IC, OA, and lateral line photophores, the following rows are present: between the IC and OA *one* row of minute dots reaching well past the anal origin in the larger

specimen, not quite reaching the ventral base in the smaller; between the OA and lateral line *one* row of minute dots extending about to the anal origin in the larger fish and halfway between the ventrals and the anal origin in the smaller one; above the lateral line *three* similar rows in the larger specimen, only *one* in the smaller one, reaching below or beyond the dorsal fin.

Pacific specimens

The following ten specimens of the *taenia* complex have been reported from the Pacific Ocean, most of them caught at the surface.

The type of *Diplophos pacificus* Günther 1889, length 37 mm., 5° 24′ N., 147° 02′ W., found in a townet attached to the dredge after a deep haul; inadequately described and now in poor condition.

The type of *Diplophos proximus* Parr 1931, standard length *ca.* 82 mm., Gulf of California, 24° 07′ N., 108° 40′ W., 523 meters; differs from *taenia* in number of photophores but not significantly in proportions.

A specimen 43 mm. long from the Solomon Islands, identified as *D. pacificus* but not described, by Seale (1935, p. 340).

The type of *Diplophos taenia orientalis* Matsubara 1940, total length 195 mm., standard length 179.8 mm., off Huji River, near Kambara, Japan, 306 meters; largest known specimen of the group, differing from *taenia* principally in photophore counts.

A second specimen of *D. orientalis,* total length *ca.* 195 mm., taken off Kambara, Suruga Bay, Japan (Abe, 1958, p. 1241, pl. 238, fig. 598).

Five specimens, 34-41 mm. long, Sulu Sea, 6° 48.5′ N., 118° 51.5′ E., surface at night, identified as *D. taenia* and partially described by Herre and Herald (1950, p. 314, fig. 2).

Twelve hitherto unreported Pacific specimens from the collection of Scripps Institution of Oceanography have been examined:

Western Pacific: One, standard length 40 mm., SIO 56-127, Marshall Island area, 13° 03′ N., 166° 04′ E., to 13° 03′ N., 166° 32′ E., 0-400 fathoms (0-732 meters).

Eastern Pacific: Five, standard length 42 and 89-100 mm., SIO 54-89, off the Revillagigedo Islands, 19° 09′ N., 110° 58.5′ W., 0-825 fathoms (0-1509 meters); one, standard length 100.5 mm.,

SIO 54-93, same area, 21° 01′ N., 115° 39′ W. to 21° 04.5′ N., 115° 48′ W.; one, standard length 90 mm., SIO 54-88, same area, 20° 16′ N., 111° 32.2′ W. to 20° 03.2′ N., 111° 20′ W., 0-25 fathoms (0-45 meters); two, standard length 81 and 88.5 mm. SIO 54-92, same area, 19° 52′ N., 113° 20.5′ W., to 19° 57.5′ N., 113° 32.5′W., 0-100 fathoms (0-183 meters); one, standard length 91 mm., SIO 55-213, west of Clipperton Island, 11° 13′ N., 120° 57′ W., 0-63 fathoms (0-115 meters); one, standard length 97.5 mm., SIO 54-95, off Lower California, 23° 05′ N., 119° 08′ W. to 22° 23′ N., 119° 36′ W., 0-1333 fathoms (0-2438 meters).

Counts and proportions of some of these Pacific specimens are shown in Table 2, those of Atlantic specimens in Table 1. The consistently lower counts found in Pacific specimens suggest that they belong to a distinct species or subspecies. It is unfortunate that the type of *D. pacificus*, the first species described from the Pacific, is small and now in poor condition, and it is also unfortunate that no large Atlantic specimens are available for comparison with eastern Pacific specimens. Small but well developed pseudobranchiae are present on all of the larger eastern Pacific specimens and their apparent absence in Atlantic specimens examined is probably questionable, especially as Brauer (*loc. cit.*) noted their presence in an eastern Atlantic example.

The eastern Pacific specimens have one small tooth on each side of the vomer; and a row of four to seven small teeth and some additional minute teeth on each palatine. There are no teeth on the pterygoids, and usually none on the tongue, but several specimens do have a cluster of three or four very small teeth at the tip of the tongue. Small teeth on the tip of the tongue were described in both specimens of *D. orientalis* but have not been mentioned in any other description of a *Diplophos* except *maderensis*. Larger specimens have three tiny photophores in a vertical series above the lower posterior OP, and several in a horizontal series between the two lower OP. All eastern Pacific specimens except the smallest have a pair of thread-like strips of luminous(?) tissue below the ninth to fifteenth IV photophores (below the fourteenth to seventeenth in the two Atlantic specimens examined). The OA number 60-61 and reach a vertical from about the middle of the anal fin in three specimens. On a fourth they number 84 and reach the

caudal base, but the organs on the latter half of the tail are minute. Few of these Pacific fishes are intact but those retaining most of their skin possess the following rows of minute photophores on the body: between the IC and OA *one* row, reaching slightly past the anal origin; between the OA and lateral line *three* rows, the lower and upper reaching well past the anal origin and the middle row to about halfway between the ventral bases and the anal origin; above the lateral line *three* rows, one of them reaching the caudal base.

The 40 mm. specimen taken off the Marshall Islands lacks both pterygoid and tongue teeth, and has no luminous tissue on the ventral surface of the body; the premaxillary and toothed portion of the maxillary are equal in length; two small teeth are present on each side of the vomer; and each palatine bears five small teeth.

D. orientalis Matsubara should probably be retained as a distinct species, at least until intermediate sizes are found. In appearance it somewhat resembles *D. maderensis,* although its characters are distinctly those of the subgenus *Diplophos.* A similarity to *Manducus* is seen in the deeper body and the heavy, fang-like premaxillary teeth. Even in the largest eastern Pacific specimen seen, standard length 100.5 mm., the long premaxillary teeth are slender and needle-like. It is possible, of course, that *D. orientalis* merely represents the adult Pacific *Diplophos.* The higher OA count (87), greater body depth, and even the enlarged premaxillary teeth, might be attributed to the large size of the only two specimens known (177 and *ca.* 180 mm. in standard length). On the other hand, one of the eastern Pacific specimens (SIO 54-88), 90 mm. in standard length, is a female with large ovaries which contain small and probably immature eggs. It is interesting that Abe (1958, p. 1242) described a narrow, semi-transparent band along the mid-ventral line of this species, with the inference that the area may be luminous.

Subgenus MANDUCUS Goode and Bean 1895

The subgenus *Manducus* differs from the subgenus *Diplophos* in the following respects (cf. p. 77).

Angle of preopercle slightly acute. No pseudobranchiae. Gill rakers 8-9 + 3-5 on first arch. Premaxillary at least as long as

toothed portion of maxillary, sometimes slightly longer. Head and trunk longer than tail, proportionately more so in adult. Origin of dorsal fin slightly behind middle of body length, close to mid-body in young. Origin of anal fin slightly behind a vertical from last dorsal ray. Ventral bases slightly in front of dorsal origin. Photophores all relatively inconspicuous, some on head (especially the SO and lower anterior OP) obscured by bone. On upper part of head in addition to ORB and OP, one small organ above anterior toothed portion of maxillary; a second one level with and not far behind it; and one small photophore beneath end of maxillary. Area just below symphysis of lower jaw blackish and occupied by two short series of 2-4 minute ring-like spots (photophores?). A row of about 10-13 minute photophores on posterior portion of lower jaw, the first one enlarged. No patches of luminous tissue on head or body as far as known except a pair of narrow strips of pale tissue, possibly luminous, below eighth to eleventh or twelfth IV photophores. AC photophores evenly spaced. BR 8-9. IV 30-33. VAV 12-14. AC 28-30. IC 70-75. OA 45-48, reaching about to or beyond middle of anal fin and followed by 12-17 much smaller organs, which reach caudal base in complete specimens. Lateral line row 65-68. Anal rays 36-41. Vertebrae 63.

The subgenus contains only the following species.

Diplophos maderensis (Johnson) 1890

This species is known only in the North Atlantic, and the only adults recorded in the literature have been found at Madeira. It is therefore of interest that during a recent cruise made by the *Oregon* twenty specimens, 94.5-144.5 mm. in standard length, were caught in a trawl off Surinam at Station 2008, 7° 38′ N., 54° 43′ W., 7 November 1957, in 250 fathoms (457 meters). I have also examined five specimens, 98.5-133 mm. in standard length, sent by Mr. G. E. Maul from Madeira, where they were found on the beach at Funchal in November 1954; and one young specimen, standard length 32 mm., from the Bahamas, reported under the name *Diplophos minutus* by Parr (1937, p. 46).

The following counts have been made on adult specimens: dorsal rays 12-13, anal rays 38-41, pectoral rays 10-11, ventral rays 8, branchiostegal rays 11-3, gill rakers on first arch 8-9 + 3-5,

vertebrae 63 (counted on an X-ray photograph of one Madeiran specimen). BR 8-9; IV 30-33, the last one or two smaller and situated just in front of or on ventral bases; VAV 12-13; AC 28-30; IC 70-75; OA 45-48, followed by smaller organs to caudal base; lateral line *ca.* 65-68.

Each premaxillary has a row of 3-7 enlarged teeth of varying sizes, the second and third the largest, and a few very small teeth between the fangs; all of these teeth are inclined slightly backward. On the maxillary is a row of closer-set, unequal teeth, all straight and all smaller than the long premaxillary teeth. On each mandible is a row of widely spaced fangs and posteriorly a few smaller teeth between the fangs. Anteriorly, there are no small teeth between the fangs but there is an outer row of 4-6 teeth, smaller than the fangs but larger than the interspace teeth.

There are 1-6 small teeth on each side of the vomer; a row of 9-15 small teeth on each palatine, the first one or two slightly enlarged; a patch of minute teeth on each pterygoid; and a cluster of small teeth near the tip of the tongue. It should be noted that Maul (1948, p. 33) found no vomerine teeth on three specimens from Madeira although these are present in all specimens examined, including six from Madeira; and that Welsh (1923, p. 1) found no palatine teeth on juvenile specimens from the Bahamas and Florida. Welsh also reported eleven BR photophores, while specimens examined have only eight or nine, and a higher number has not been mentioned by other authors. It is possible that the two lower opercular organs were included in Welsh's count.

The scales are mostly lost but it is evident that the dorsal and ventral surfaces are fully scaled, neither "rugosely warted" as described by Johnson (1890, p. 458), nor "keeled" as described by Maul (*loc. cit.*).

In addition to the IC, OA and lateral line rows, the following rows of photophores are present on the body: between the OA and the lateral line, *three* rows of smaller organs, the first of these reaching about to a vertical from the middle of the anal fin and continued posteriorly as still smaller round spots, sometimes to the end of the anal fin, sometimes to the base of the caudal; the second is traceable in one specimen nearly to the end

of the anal but is shorter in other specimens; and the third is obscure, apparently shorter, not reaching the anal origin. Above the lateral line are *two* rows of obscure spots, reaching at least beyond the end of the dorsal fin, sometimes to a vertical from the middle of the anal fin; and, in two specimens, a *third* row commencing in one instance above the other two, in the other case beneath the anterior portion of the dorsal fin. There is also *one* row of small round organs between the IC and OA, reaching to beneath the last of the larger OA organs.

The following measurements, in per cent of the standard length, are based on six western Atlantic specimens, standard length 94.5-144 mm., and five specimens from Madeira, standard length 98.5-133 mm. The figures in parentheses refer to the latter. Depth 15.8-16.9 (15.5-16.8); head 20.1-21.3 (21.1-21..6); snout 4.4-5.1 (4.5-5.1); orbit 3.6-4.2 (3.3-3.8); interorbital width at center of eye 3.7-4.1 (4.0-5.1); upper jaw 14.6-15.5 (14.8-15.6); premaxillary 7.4-7.9 (7.5-7.9); toothed portion of maxillary 6.9-7.8 (7.2-7.8); tip of snout to dorsal origin 51.8-53.1 (49.5-52.2), to anal origin 61.5-62.5 (59.0-63.0), to ventral bases 45.5-46.8 (45.2-46.3); distance between first anal ray and base of middle caudal rays 36.5-39.2 (37.6-41.2), last anal ray and base of middle caudal rays 5.9-7.6 (6.0-7.2), last dorsal ray and base of middle caudal rays 38.1-40.2 (38.7-40.0), ventral bases and anal origin 14.7-16.9 (14.8-17.6); least depth of caudal peduncle 5.4-5.9 (4.3-5.1); dorsal base 7.2-8.7 (8.0-8.7); anal base 30.3-31.8 (30.0-34.0); pectoral length *ca.* 16.2 (one specimen only); ventral length 9.75-11.1 (all broken in Madeiran specimens).

Yarrella Goode and Bean 1895

Yarrella Goode and Bean, 1895, Ocean. Ichth., p. 103, type species *Yarrella blackfordi* Goode and Bean 1895, Gulf of Mexico, 324 fathoms (593 meters); Jordan and Evermann, 1896, Bull. U. S. Nat. Mus., **47:** 583.

Lychnopoles Garman, 1899, Mem. Mus. Comp. Zool., **24:** 244.

Diplophos Parr, 1931, Bull. Bingham Oceanogr. Coll., **2** (4): 11 (part, *Lychnopoles* in synonymy).

Manducus Fowler, 1936, Bull. Amer. Mus. Nat. Hist., **70:** 1202 (part, *Lychnopoles* in synonymy).

Generic characters. Eye normal, moderate. Snout longer than orbit. Interorbital width at center of eye greater than diameter of orbit. Mouth large, oblique; edge of premaxillary straight

laterally; toothed edge of maxillary slightly convex, nearly reaching preopercle. Premaxillary longer than toothed portion of maxillary. Angle of preopercle quite acute. Teeth of upper jaw biserial on premaxillary, those of inner row smaller and curving inward; uniserial on maxillary. Teeth of lower jaw biserial, similar to those of premaxillary but somewhat smaller. Vomer with one to three small teeth on each side. Palatines each with a short row of two to six small teeth. Pterygoids usually toothless but a few specimens seen with one or several microscopic teeth present. Tongue toothless. Gill rakers 12-16 + 6-7 = 18-22 on first arch. Spines on inner edge of first gill arch very short, a row of minute spines below each one. No pseudobranchiae. Scales present, very deciduous. Anus close to anal fin. Head and trunk longer than tail. Dorsal origin about in middle of body length or slightly behind it. Anal origin beneath middle or front of dorsal fin. Ventral bases well ahead of doral origin. No adipose fin. ORB 1, in front of lower margin of eye. OP 3, obscure, upper one level with upper edge of pupil, lower ones level with end of maxillary. SO present, slightly behind symphysis and somewhat laterally situated. BR 11-13. Body with ventral and lateral rows of photophores typical of family and also several rows above these. Photophores present on isthmus. IV 9 + 3-4 + 11-12 = 23-25. VAV 9-12. AC 20-28, straight, 6-10 of them behind anal fin. IC 52-64. OA probably always about 50 or more, reaching caudal base. No additional photophores on head, and no patches of luminous tissue on head or body as far as known. Fin rays: dorsal 14-16 (17 in one specimen of *blackfordi*), anal 28-31, pectoral 8-10, ventral 6-7. Branchiostegal rays 13-16, no spines at bases. Vertebrae 45-54.

Remarks. *Yarrella* shows relationship to *Triplophos* in the arrangement of the body photophores, the long premaxillary, and the dentition; and to *Polymetme* in dentition, the position of the fins, and many proportions. An examination of two specimens from the type lot of *Lychnopoles argenteolus* Garman has shown them to be congeneric with *Y. blackfordi*. As in the latter, the toothed portion of the maxillary is slightly shorter than the premaxillary, the dentition is similar (although the teeth of *Y. argenteola* are somewhat smaller than those of *Y. blackfordi*), and the pattern and arrangement of the body photophores are

similar in the two species. Specific differences are set forth in Table 3.

The discovery that *Yarrella* has more than two rows of photophores on the body clarifies the confusion that has resulted in the past from a misunderstanding of the genus, and necessitates the removal of all species described under the name except the type species, *blackfordi*. Although the species referred here to *Polymetme* do appear to be somewhat related to *Yarrella*, the rather common, small form, *Pollichthys mauli* (Poll), confused with *Y. blackfordi* until renamed *Y. mauli* by Poll (1953, p. 59), is quite different and, as noted by Jespersen and Tåning (1919, p. 223), is more closely related to *Vinciguerria*.

Yarrella blackfordi Goode and Bean 1895
Figure 2

Yarrella blackfordi Goode and Bean, 1895, Ocean. Ichth., p. 103, fig. 121; Jordan and Evermann, 1896, Bull. U. S. Nat. Mus., **47:** 584; 1900, *op. cit.*, fig. 249; Poll, 1953, Rés. Sci. Exp. Océanogr. Belge (1948-1949), **4** (2), (3): 56, fig. 22; Springer and Bullis, 1956, Spec. Sci. Rep. U. S. Dept. Int., Fish., **196:** 50 (part).

The following unrecorded specimens have been examined.

Gulf of Mexico, *Oregon:* Station 126, 29° 02′ N., 88° 34.5′ W., 23 September 1950, 195 fathoms (357 meters); one specimen, standard length *ca.* 202 mm. Station 279, 29° 11′ N., 86° 52′ W., 24 February 1951, 305 fathoms (558 meters); three specimens, 180-200 mm. Station 543, 27° 38.2′ N., 94° 59.4′ W., 16 April 1952, 350-400 fathoms (640-732 meters); two specimens, 170 and 261 mm. Station 597, 29° 13′ N., 87° 59′ W., 10 July 1952, 280 fathoms (512 meters); two specimens, 212 mm. Station 640, 20° 01′ N., 88° 24′ W., 19 September 1952, 355-475 fathoms (649-869 meters); two specimens, 200 and 212 mm. Station 1019, 24° 16′ N., 83° 22′ W., 16 April 1954, 375 fathoms (686 meters); one specimen, 200 mm. Station 1272, 28° 20′ N., 89° 46′ W., 8 March 1955, 250 fathoms (457 meters), 49°F. at bottom; two specimens, U.S.N.M. No. 157908, 204 and 213.5 mm.

Off northern South America, *Oregon:* Station 1980, 10° 10′ N., 59° 54′ W., 3 November 1957, 350 fathoms (640 meters), 58.6°F. at bottom; one specimen, 163 mm. Station 2009, 07° 40′ N., 54°

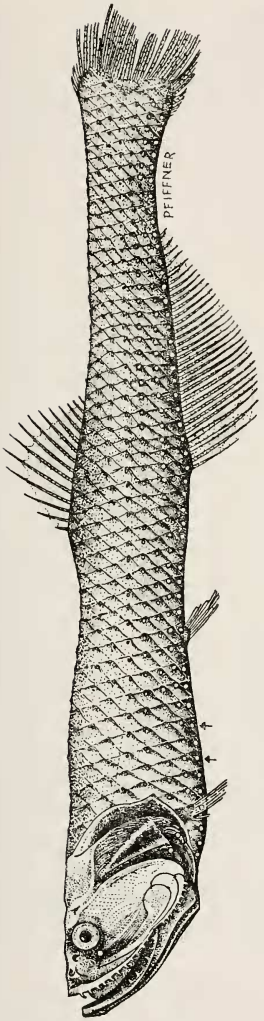

Figure 2. *Yarrella blackfordi* Goode and Bean. *Oregon* Station No. 2010. Standard length 193 mm.

Figure 2a. Vertical section, enlarged, of area indicated by arrows.

47′ W., 7 November 1957, 300 fathoms (549 meters); five specimens, 190-200 mm. Station 2010, 07° 44′ N., 54° 40′ W., 7 November 1957, 350 fathoms (640 meters); fifty-four specimens, 133-222 mm. Station 2011, 07° 46′ N., 54° 36′ W., 7 November 1957, 400 fathoms (732 meters); eight specimens, 144.5-274 mm.

One specimen, 222 mm., Stanford University No. 9486, *Albatross* Station 2376 (type locality), 29° 03′ 15″ N., 88° 16′ W., Gulf of Mexico, 324 fathoms (592 meters).

One specimen, 148.5 mm., University of Miami Marine Laboratory No. 1678, *Antilles*, Gulf of Mexico, 28° 36′ N., 89° 49′ W., 234 fathoms (428 meters).

The only certain previous records of *Y. blackfordi* are the type series (three specimens) from the Gulf of Mexico and thirty-nine specimens reported by Poll (1953, p. 56) from the eastern Atlantic off Africa, 5°-11° S. The two larger specimens mentioned by Longley and Hildebrand (1941, p. 15), taken south of Tortugas in 672-686 meters, may have been *blackfordi*, but the smaller one, which I have examined, belongs to *Polymetme corythaeola*. Other Atlantic reports were of undescribed material and either cannot be identified or are referable to *Pollichthys mauli*. Two little specimens tentatively identified as *Y. blackfordi* by Koefoed (1958, p. 6) have been examined and are not referable to this species. The larger one is a young *Gonostoma*, sp. indet., and the smaller, which is in very poor condition, appears to be a juvenile maurolicid but cannot be identified further.

The skin of this species is extremely fragile and is almost entirely lost in most of the specimens at hand. In fact, not a single specimen has its full complement of skin, although many from *Oregon* Station 2010 retain much of it. Many of the photophores, especially those of the lateral and accessory series, have been lost with the skin and the condition of other recorded specimens was apparently similar. Dr. Leonard P. Schultz has been kind enough to examine the types of *Y. blackfordi* and has written (*in litt.*, 1956) that these still retain shreds of skin on which are found portions of the rows of photophores above the lateral series.

The photophores are moderate to small in size and are rather inconspicuous. There are usually 12 BR (13 in one specimen)

and other counts are as follows: IV 9 + 3-4 + 11-12 = 24-25, the three or four pre-pectoral organs smaller than those preceding or following them; VAV 12; AC 24-27 (28 in one specimen), eight to ten of them behind anal fin; OA probably always reaching caudal base, count indeterminable on all but three specimens, on which were counted 52, 52 and 53 photophores. Above the OA are *three* rows of photophores, the *first* of these (just above the OA), apparently reaching a little beyond the ventral bases and numbering about 15-16 organs. The *second* and *third* rows reach the caudal base but the number of photophores, which are very small posteriorly, is indeterminable. In addition to the photophores described there are clusters of minute round organs on the edges of the scale pockets. These are associated with all serial photophores above the ventral row (IC) and also form *two* rows above the uppermost row of serial photophores, both rows of clustered organs reaching the caudal base.

Triplophos Brauer 1902

Triplophos Brauer, 1902, Zool. Anz., **25:** 282; type species *Triplophos elongatus* Brauer 1902 = *Photichthys hemingi* McArdle 1901; 1906, Wiss. Ergebn. Deutschen Tiefsee Exp. Valdivia, **15** (1): 98; Norman, 1930, Discovery Rep., **2:** 296; Misra, 1953, Rec. Indian Mus., **50:** 398.

Generic characters. Eye normal, moderate. Snout shorter than orbit. Interorbital width at center of eye equal to diameter of orbit or a little shorter. Mouth large, slightly oblique; edge of premaxillary straight, toothed edge of maxillary slightly convex, nearly reaching preopercle. Premaxillary much longer than toothed portion of maxillary, which is very short and scarcely enters the gape. Angle of preopercle very acute. Premaxillary teeth biserial, well spaced, those of inner row curving inward (described as uniserial by Brauer). Maxillary with only a few teeth in a single row. Teeth of lower jaw in specimens examined similar to those of premaxillary, outer row set slightly lower and curving inward; described as uniserial by other authors. Vomer toothless or with one tooth on each side. Palatines each with a short row of small teeth, the anterior one sometimes slightly enlarged. Pterygoids with or without teeth. Tongue toothless. Gill rakers 14-16 + 9 = 23-25 on first arch. Spines on inner edge of first gill arch short, a row of minute prickles below each one.

No pseudobranchiae. Scales present but very deciduous. Anus close to anal fin. Head and trunk much shorter than tail. Dorsal origin far in advance of middle of body length. Anal origin beneath last dorsal ray or just behind a vertical from it. Ventral bases a little in front of dorsal origin. No adipose fin. ORB 1, below center of eye. OP 3 (more easily seen from inside opercle), upper one level with upper margin of eye, lower anterior one beneath maxillary, lower posterior one on same level. SO present, slightly behind symphysis, hidden by lower jaw. BR 8-13. Additional photophores on head: one, large, above maxillary; and a row of tiny organs above and close to premaxillary. Body with ventral and lateral rows of photophores typical of family and also several rows or partial rows above these. Photophores present on isthmus. IV 24-30, one or two raised toward pectoral base, those following commencing below the last raised organ. VAV 5-7. AC 35-41, straight, two or three of them behind anal fin. IC 68-76. OA 50-56, the first 9-11 lower than those following. Above OA three or four additional rows of photophores. No patches of luminous tissue on head or body as far as known. Fin rays: dorsal 10-12, anal 54-63, pectoral 9-11, ventral 6-7. Branchiostegal rays 11-14 (17?), no spines at bases. Vertebrae probably *ca.* 60 (counted from X-ray photograph of one specimen, indistinct on tail).

Remarks. Triplophos stands apart from all other gonostomatid genera in the relative lengths of the premaxillary and maxillary bones, and from all except *Danaphos* in the advanced position of the dorsal fin. It is perhaps most closely related to *Yarrella.* According to Brauer (1908, pp. 27, 123) *Triplophos* is similar to *Diplophos* in some ways, but the structure of the photophores is close to that of *Maurolicus* and *Valenciennellus,* as well as the Sternoptychidae. The fact that the premaxillary forms almost the entire upper jaw somewhat strengthens the relationship between *Triplophos* and *Yarrella,* the latter having a lengthened premaxillary as well as additional photophores on the body. Brauer's statement (1906, p. 99) that the premaxillary is short in *Triplophos* must have been an error. In specimens at hand it forms almost the entire upper border of the mouth, the maxillary being reduced to a small round knob bearing five or six small teeth.

The generic diagnosis has been based in part on previous descriptions of specimens from the eastern Atlantic and the Indian Ocean, and in part on the newly discovered western Atlantic specimens listed below.

Triplophos hemingi (McArdle) 1901

Photichthys hemingi McArdle, 1901, Ann. Mag. Nat. Hist., (7) **8:** 521; Alcock and McGilchrist, 1905, Ill. Zool. Investigator, Fishes, pl. 36, fig. 2 (holotype).

Triplophos elongatus Brauer, 1902, Zool. Anz., **25:** 282; 1906, Wiss. Ergebn. Deutschen Tiefsee Exp. Valdivia, **15** (1): 99, pl. 7, fig. 4, text fig. 41 (*elongatum*); 1908, *op. cit.*, **15** (2): 27, 176, pl. 22, figs. 4-7, pl. 36, fig. 8 (*elongatum*); Misra, 1950, Rec. Indian Mus., **45:** 415 (*elongata*); 1953, *op. cit.*, **50:** 399, fig. 15b.

Triplophos hemingi Lloyd, 1909, Mem. Indian Mus., **2:** 150; Norman, 1930, Discovery Rep., **2:** 296; Poll, 1953, Rés. Sci. Exp. Océanogr. Belge (1948-1949), **4**, (2), (3): 61, fig. 25.

Three specimens, 106-130 mm. in standard length, *Oregon* Station 1907, Caribbean Sea off Central America, 12° 25′ N., 82° 23′ W., 11 September 1957, trawl, 400-425 fathoms (732-778 meters); one specimen, 122 mm., *Oregon* Station 1916, same area, 13° 18′ N., 82° 12′ W., 12 September 1957, trawl, 350 fathoms (640 meters); two specimens, *ca.* 176 mm., *Oregon* Station 2007, off Surinam, 07° 34′ N., 54° 49′ W., 7 November 1957, trawl, 225 fathoms (411 meters), 47.5° F. at bottom.

Although these specimens differ slightly from descriptions based on Indian Ocean specimens, the differences do not seem important enough to warrant their separation as a distinct species. All six specimens examined have seven VAV photophores, in contrast to a count of five in Indian Ocean examples. However, Brauer's figure (1906, p. 99, fig. 41) shows six photophores between the ventral bases and the anal origin; and Poll (1957, *in litt.*) has written that VAV counts in sixteen of the eastern Atlantic specimens reported by him in 1953 are seven, six, and (in one specimen) five. The IV count of our specimens is lower, 24-25 (29-30 in Indian Ocean specimens). The first row of serial photophores above the OA has been described and figured as short, and the one above it with a count of 36-43. In specimens examined this short row appears to be continuous

with the row that extends on the tail, but the first nine photophores are on a lower level than those following. Similarly, the first nine organs of the OA series are slightly below those following them. The uppermost rows of photophores are smaller and do not reach the tail.

The only significant proportional differences noted (Table 4), a shorter pre-anal distance and a longer anal base in Indian Ocean specimens, need to be verified by direct comparison of material from both oceans. Further information is also needed on the jaw teeth. The teeth on the premaxillary have been described as biserial, as they are in specimens examined, by all authors except Brauer. However, all authors have stated that the lower jaw teeth are in a single row, and in the western Atlantic specimens there is, along most of the mandible, an outer row of teeth, curving inward and set somewhat below the inner row.

The vomer is toothless or has one minute tooth on each side. Each palatine has a short row of 2-6 teeth, microscopic in size excepting the first one or two. The pterygoids and tongue are toothless.

The photophores are moderate in size. The row of tiny organs above the premaxillary is usually difficult to see, or damaged. The OA organs number 50-55, the first nine slightly lower than those following, and those on the tail diminishing in size posteriorly. These reach the end of the anal fin in one specimen (*ca.* 118 mm. in standard length), not quite to the end of the anal fin in others. Above the OA are three or four rows of small photophores, 39-47 in the lowest of these, which reaches beyond the middle of the anal fin in all but the smallest specimen; the first nine are on a slightly lower level. The upper rows of photophores are not complete. An additional photophore is present close to the opercle between the IC and the OA.

Polymetme McCulloch 1926

Polymetme McCulloch, 1926, Biol. Res. Endeavour, **5:** 166; type species *Polymetme illustris* McCulloch 1926, southern Australia; Barnard, 1927, Ann. So. Afr. Mus., **21:** 1018; McCulloch, 1929-30, Mem. Australian Mus., **5:** 51.

Yarrella Barnard, 1925, Ann. So. Afr. Mus., **21:** 148; Norman, 1930, Discovery Rep., **2:** 288 (part); Matsubara, 1938, Jour. Imp. Fish. Inst. Tokyo, **33:** 44 (part); Smith, 1949, Sea Fishes So. Afr., p. 104 (part); Misra, 1953, Rec. Indian Mus., **50:** 398.

Generic characters. Eye normal, moderate. Snout about equal to diameter of orbit. Interorbital width at center of eye about equal to or a little less than diameter of orbit. Mouth large, oblique, edge of premaxillary straight; toothed edge of maxillary slightly convex, nearly reaching preopercle. Premaxillary more than half as long as toothed portion of maxillary. Angle of preopercle acute. Teeth of upper jaw biserial on premaxillary, uniserial on maxillary. Teeth of lower jaw biserial, those of outer row larger. Vomer with one to three teeth on each side. Palatines each with a short row of small teeth. Pterygoids with a rather large patch of minute teeth (not described in type species, *illustris*). Tongue toothless. Gill rakers 9-12 + 5-8 = 15-19 on first arch. Spines on inner edge of first gill arch very short, a cluster of minute prickles below each one. No pseudobranchiae. Scales present but very deciduous. Anus close to anal fin. Head and trunk a little longer than tail. Dorsal origin about in middle of body length. Anal origin beneath end of dorsal fin or just behind a vertical from its last ray. Ventral bases noticeably ahead of dorsal origin. Adipose fin above end of anal fin. ORB 1, in front of lower margin of eye. OP 3, upper one smaller, about on a level with upper border of pupil or higher; lower anterior one just behind maxillary; lower posterior one slightly higher. SO present. BR 9-10. No other photophores on head. Body with two rows of photophores; photophores present on isthmus. IV 19-21, ninth or tenth raised toward pectoral base. VAV 7-8. AC 21-25, first one or two elevated and sometimes elongate, five to eight of them behind anal fin. IC 50-54. OA 16-18, not always perfectly straight, ending above next to last VAV. No additional photophores and no patches of luminous tissue on head or body as far as known (but see p. 99). Fin rays: dorsal 11-13, anal 24-33, pectoral 9-11, ventral 7 (8?). Branchiostegal rays 12-14, no spines at bases. Vertebrae 45, counted from an X-ray photograph of one western Atlantic specimen.

Remarks. Polymetme is apparently related to *Yarrella,* judging by the relatively long premaxillary and the partially biserial teeth on the jaws. It differs, however, in the number and arrangement of the serial rows of photophores, in the larger and more conspicuous individual photophores, and in having an adipose fin.

Polymetme is similar to *Pollichthys* in the possession of an adi pose fin, the length of the anal fin, the number of BR photophores, and in having only two rows of body photophores. It differs from that genus principally in having only one ORB, ten pectoral rays (eight in *Pollichthys*) and two rows of teeth on the premaxillary.

This genus has for many years been considered synonymous with *Yarrella* and is reinstated here to include the following species, some or most of which are probably synonymous: *Diplophos corythaeolum* Alcock, Andaman Sea (and *Yarrella corythaeola* Poll, West Africa); *Yarrella africana* Gilchrist and von Bonde, Natal coast; *Polymetme illustris* McCulloch, Australia (and *Yarrella blackfordi illustris* Matsubara, Japan); *Yarrella blackfordi elongata* Matsubara, Japan; and *Yarrella surugaensis* Matsubara, Japan. In the absence of comparative material it is not possible to determine the number of valid species belonging to the genus, but *africana* is probably a synonym of *corythaeola*. *surugaensis* is probably the same as *illustris*, and actually all four of these species may be synonymous. *P. surugaensis* was distinguished from *P. illustris* on the basis of the irregularity of the OA photophores and slight differences in the number of anal rays, gill rakers, and AC photophores. These small variations do not seem to warrant the separation of *surugaensis*, particularly in view of the fact that the OA photophores are usually irregular in specimens examined from the western Atlantic.

In the original diagnosis of the genus, McCulloch (1926, p. 166) stated that the upper jaw is formed largely by the maxillary, and the figure of the type of *illustris* (McCulloch, *loc. cit.*, pl. 45, fig. 1) shows this bone to be proportionately somewhat longer than in Atlantic specimens examined. The maxillary is also proportionately longer in Matsubara's figures of *illustris* (1938, p. 42, fig. 4) and *surugaensis* (1943, p. 74, fig. 22). On the other hand, in Alcock's figure of the Indian Ocean *corythaeola* (Ill. Zool. Investigator, 1899, pl. 25, fig. 3) the premaxillary is nearly as long as the toothed portion of the maxillary, as it is in specimens at hand, and the same is true of Matsubara's figure of the Japanese *elongata* (1938, p. 45, fig. 5), Poll's figure of an eastern Atlantic specimen (1953, p. 58, fig. 23), and Smith's South African specimen (1949, p. 104, fig. 152). The relative

length of these two bones was not described for *africana* by Gilchrist and von Bonde (1924, p. 8, pl. 1, fig. 2) nor can they be distinguished in the figure of the type. Norman (1930, p. 289), who had both Australian and Indian Ocean specimens at hand, unhesitatingly synonymized *illustris* with *corythaeola* and his opinion should probably be upheld for the present.

Polymetme elongata (Matsubara) 1938, from Japan, is probably a distinct species. It differs from both *illustris* and *corythaeola* in having a smaller head, shorter snout and upper jaw, and lesser depth, as noted by Matsubara, and it may differ further, from *illustris* at least, in having a relatively longer premaxillary.

Yarrella blackfordi microcephala Matsubara (1941, p. 1) probably does not belong to the genus *Polymetme*. It differs in the following significant characters: tail very slender; anal origin beneath fifth dorsal ray; BR 8; OA 25, ending above fourth anal ray. It cannot, however, be assigned to any genus examined by me. In the position of the anal fin, the slender tail, and the number of BR and IV photophores it is like *Pollichthys*, but it differs from that genus in having a single ORB, two rows of teeth on the premaxillary, and ten pectoral rays (eight in *Pollichthys*). The species has not been figured.

Polymetme corythaeola (Alcock) 1898

Diplophos corythaeolum Alcock, 1898, Ann. Mag. Nat. Hist., (7) **2**: 147; 1899, Ill. Zool. Investigator, Fishes, pl. 25, fig. 3; 1902, Nat. Indian Seas, p. 239, fig. 38; Parr, 1931, Bull. Bingham Oceanogr. Coll., **2** (4): 12, 13.

Photichthys corythaeolus Alcock, 1899, Cat. Indian Deep-sea Fishes, p. 142; Brauer, 1906, Wiss. Ergebn. Deutschen Tiefsee Exp. Valdivia, **15** (1): 92, 374.

Yarrella africana Gilchrist and von Bonde, 1924, Rep. Fish. Mar. Biol. Surv. So. Afr., **3** (7): 8, pl. 1, fig. 2; Barnard, 1925, Ann. So. Afr. Mus., **21**: 148.

? Polymetme illustris McCulloch, 1926, Biol. Res. Endeavour, **5**: 167, pl. 45, fig. 1; 1929-30, Mem. Australian Mus., **5**: 51; Whitley, 1948, Fish. Bull. West. Australia Fish. Dept., **2**: 11.

Polymetme africana McCulloch, 1926, Biol. Res. Endeavour, **5**: 167; Barnard, 1927, Ann. So. Afr. Mus., **21**: 1018.

Polymetme corythaeolus McCulloch, 1926, Biol. Res. Endeavour, **5**: 167.

Yarrella corythaeola Norman, 1930, Discovery Rep., **2:** 289; Barnard, 1937, Ann. So. Afr. Mus., **32:** 46; Norman, 1939, Sci. Rep. John Murray Exp. 1933-34, **7** (1): 19; Bertin, 1939, Bull. Mus. Hist. Nat. Paris, **11:** 379; Herre, 1941, Mem. Indian Mus., **13:** 336; Smith, 1949, Sea Fishes So. Afr., p. 104, fig. 152; Misra, 1950, Rec. Indian Mus., **45:** 415; 1953, *op. cit.*, **50:** 398, fig. 17a; Poll, 1953, Rés. Sci. Exp. Océanogr. Belge (1948-1949), **4** (2), (3): 58, fig. 23; Springer and Bullis, 1956, Spec. Sci. Rep. U. S. Dept. Int., Fish., **196:** 50.

? *Yarrella corythaeola* Kamohara, *1936, Zool. Mag., Tokyo, **48.**

? *Yarrella illustris* Kamohara, 1938, Offshore Bottom Fishes Prov. Tosa, p. 9; Matsubara, 1955, Fish Morph. Heir., **1:** 221, pl. 16, fig. 61.

? *Yarrella blackfordi illustris* Matsubara, 1938, Jour. Imp. Fish. Inst. Tokyo, **33:** 42, fig. 4; 1940, Suisan Kenkiu-shi, **35:** 319; Kamohara, 1952, Rep. Kochi Univ. Nat. Sci., **3:** 16; Haneda, 1952, Pacific Sci., **6:** 13.

Yarrella blackfordi corythaeola Matsubara, 1938, Jour. Imp. Fish. Inst. Tokyo, **33:** 44.

Yarrella blackfordi africana Matsubara, 1938, *loc. cit.*

Yarrella blackfordi Longley and Hildebrand, 1941, Publ. Carnegie Inst. Washington, **535:** 15 (part); Springer and Bullis, 1956, Spec. Sci. Rep. U. S. Dept. Int., Fish., **196:** 50 (part).

? *Yarrella surugaensis* Matsubara, 1943, Jour. Sigen. Kenk., **1:** 74, fig. 22; 1955, Fish Morph. Heir., **1:** 221, pl. 17, fig. 63; Kamohara, 1957, Res. Rep. Kochi Univ., **6** (5): 1.

Photichthys argenteus Bruun, 1950, Atlantide Rep., **1:** 20, fig. 13.

The following western Atlantic specimens have been examined.

Gulf of Mexico: One specimen, standard length 125 mm., University of Miami Marine Laboratory No. 49:769, *Antilles*, 29° 13′ N., 88° 2′ W., 200 fathoms (366 meters).

Gulf of Mexico, *Oregon:* One specimen, 113 mm., Station 382, 29° 11.5′ N., 88° 07.5′ W., 21 June 1951, 190-210 fathoms (348-384 meters); five specimens, 74-112.5 mm., Station 1054, 19° 37′ N., 92° 40′ W., 15 May 1954, 200 fathoms (366 meters), 52°F. at bottom; two specimens, 86 and 127 mm., Station 1055, 19° 14′ N., 93° 00′ W., 15 May 1954, 225 fathoms (411 meters), 50°F. at bottom; two specimens, 195 and 207 mm., U.S.N.M. No. 157907, Station 1272, 28° 20′ N., 89° 46′ W., 8 March 1955, 250 fathoms (457 meters), 49°F. at bottom; one specimen, 145 mm., U.S.N.M. No. 157909, Station 1277, 28° 32′ N., 86° 20′ W., 11 March 1955, 260 fathoms (475 meters), 48°F. at bottom; one specimen, 113.5 mm., U.S.N.M. No. 157899, Station 1407, 28° 07′ N., 89° 59′ W.,

*Starred references not seen.

20 September 1955, 258 fathoms (472 meters); one specimen, 129 mm., U.S.N.M. No. 157898, Station 1412, 27° 58′ N., 90° 41′ W., 21 September 1955, 150-175 fathoms (274-320 meters), 53°F. at bottom; one specimen, 157 mm., Station 1541, 24° 28′ N., 83° 29′ W., 15 June 1956, 220 fathoms (403 meters); four specimens, 121-134 mm., Station 1565, 29° 11′ N., 88° 02′ W., 22 June 1956, 240 fathoms (438 meters), 52.2°F. at bottom; one specimen, 146.5 mm., Station 1566, 29° 13′ N., 87° 54′ W., 22 June 1956, 250 fathoms (457 meters); one specimen, 123 mm., Station 1963, 29° 11′ N., 88° 03′ W., 24 September 1957, 240 fathoms (438 meters).

Atlantic off Florida: One specimen, *ca.* 80 mm., U.S.N.M. No. 116937, Longley Collection (reported by Longley and Hildebrand, 1941, under the name *Yarrella blackfordi*); one specimen, 133.5 mm., *Combat* Station 446, 25° 10′ N., 79° 13′ W., 23 July 1957, 250 fathoms (457 meters), between Florida and the Bahama Islands.

Caribbean Sea: One specimen, 115.5 mm., collection of the Museum of Comparative Zoology, *Blake* Exp. 1880, off Cayman Brac, 247 fathoms (452 meters).

Western Caribbean Sea, *Oregon:* Three specimens, 113-140 mm., Station 1871, 16°39′N., 82°26′W., 22 August 1957, 250 fathoms (457 meters); four specimens, 85.5-*ca.*134 mm., Station 1872, 16° 41′ N., 82° 20′ W., 22 August 1957, 300 fathoms (548 meters); one specimen, 158 mm., Station 1888, 16° 41′ N., 81° 02′ W., 23 August 1957, 250 fathoms (457 meters); two specimens, 102 and 151 mm., Station 1889, 16° 39′ N., 81° 01′ W., 24 August 1957, 250 fathoms (457 meters); two specimens, *ca.* 146 and 147 mm., Station 1902, 11° 27′ N., 83° 11′ W.. 9 September 1957, 135 fathoms (247 meters); six specimens, 123-*ca.*140 mm., Station 1903, 11° 31′ N., 83° 09′ W., 9 September 1957, 150 fathoms (274 meters); one specimen, 94 mm., Station 1919, 13° 30′ N., 82° 00′ W., 12 September 1957, 275-300 fathoms (503-549 meters); four specimens, *ca.* 49-189 mm., Station 1921, 13° 33′ N., 81° 55′ W., 13 September 1957, 275 fathoms (503 meters); one specimen, 134 mm., Station 1943, 16° 43′ N., 82° 44′ W., 16 September 1957, 275 fathoms (503 meters); seven specimens, 78-186 mm., Station 1945, 16° 41′ N., 82° 40′ W., 16 September 1957, 250-300 fathoms (457-549 meters).

Off northern South America: One specimen, *ca.* 63 mm., U.S.N.M. No. 44588, *Albatross* Station 2125, 11° 43′ N., 69° 09′ 30″ W., 18 February 1884, 208 fathoms (380 meters).

Off northern South America, *Oregon:* One specimen, *ca.* 108 mm., Station 1991, 09° 17′ N., 59° 19′ W., 4 November 1957, 250 fathoms (457 meters); four specimens, 83-152.5 mm., Station 1992, *ca.* 09° N., 59° W., 4 November 1957, 275 fathoms (503 meters); three specimens, 101.5-*ca.*140 mm., Station 2005, 07° 34′ N., 54° 50′ W., 6 November 1957, 200 fathoms (366 meters).

P. corythaeola was reported from the western Atlantic off Tortugas, Florida, by Longley and Hildebrand (1941, p. 15) under the name *Yarrella blackfordi* (see p. 88). The first Atlantic specimens were described by Poll (1953, p. 58) from West Africa, although Bertin (1939, p. 379) had earlier listed two specimens from the Cape Verde Islands, taken by the *Talisman.* Bruun (1950, p. 20) reported specimens under the name *Photichthys argenteus* Hutton, from the Gulf of Guinea, in either 530-850 or 650-260 meters. The position of the anal fin and the number and position of the lateral row of photophores (*loc. cit.,* p. 21, fig. 13) show these specimens to be *Polymetme corythaeola.* The species is otherwise known from South Africa, the tropical Indian Ocean, and possibly from the Pacific off Japan and Australia.

The following counts have been made on specimens examined: dorsal rays 11-13, anal rays 30-33, pectoral rays 10-11, ventral rays 7, branchiostegal rays 12-13, gill rakers on first arch 11-12 + 5. The photophores are large and conspicuous, their counts: BR 9; IV 9 + 1 + 11 = 21, the tenth elevated; VAV 8; AC 24-25, the first one or two slightly elevated and sometimes elongate, the last six or seven behind the anal fin; IC 53-54; OA 17 (an additional small, incomplete organ on one side of one specimen), not quite reaching a vertical from the anal origin.

There is some variation in the placement of the OA photophores. The first two are usually joined basally, i.e., the reflectors juxtaposed; two or three above the ventral fins are usually smaller, narrower, and irregularly disposed; and the last eight or nine are usually smaller and narrower, and sometimes a little higher than the pre-ventral organs. However, in

some specimens the first two OA are quite separate; in some, all of the OA are more or less equal in size and all on one level, and in one specimen the last eight organs are on a slightly lower level than the anterior ones. These variations occur at times on a single specimen, the left side differing slightly from the right.

No luminous tissue has been noted on the head or body of this species, but on most specimens there is a fragile tube of transparent skin on the belly between the ventral bases and the anus (below the VAV photophores), sometimes partially torn and probably lost in specimens lacking it. This structure is usually quite colorless but in large specimens it is sprinkled with minute black spots.

Small specimens have a proportionately longer head, larger eye, longer upper jaw and premaxillary, a shorter distance between the ventral and anal fins, and a narrower caudal peduncle. The young are also more compressed, and the body depth decreases more abruptly behind the head than in the adult. In specimens less than about 100 mm. in standard length the premaxillary and the toothed portion of the maxillary are about equal in length, while in older specimens the maxillary is always a little longer. The following measurements, in per cent of the standard length, are given in two groups, the first figures representing specimens with a standard length of more than about 115 mm. (fourteen, 118.5-207 mm.), the second groups of figures, in parentheses, representing specimens about 115 mm. or less (ten, 60.5-115.5 mm.).

Depth 14.8-17.9 (14.8-16.8); head 21.0-23.6 (23.6-*ca.* 26.0); snout 4.55-5.86 (5.1-6.16); orbit 4.2-4.83 (5.2-*ca.* 6.4); interorbital width at center of eye 3.93-4.8 (4.05-4.77); upper jaw 15.3-17.6 (18.2-19.1); premaxillary 7.0-8.4 (8.5-*ca.* 9.75); toothed portion of maxillary 7.7-9.17 (8.83-*ca.* 9.75); tip of snout to dorsal origin 46.4-49.6 (47.2-49.5), to anal origin 54.4-58.8 (54.6-57.5), to ventral bases 38.3-42.2 (*ca.* 38.3-42.5); distance between first anal ray and base of middle caudal rays 41.9-45.0 (42.3-46.0), last anal ray and base of middle caudal rays 12.1-16.7 (11.8-15.8), last dorsal ray and base of middle caudal rays 40.5-43.1 (39.0-42.5), last dorsal ray and adipose fin 17.9-20.2 (17.7-20.6), ventral base and anal origin 15.0-17.95 (12.7-16.0); least depth of caudal peduncle 5.8-6.65 (4.25-6.16); dorsal base 8.8-11.2 (8.9-*ca.* 10.75);

anal base 27.9-30.9 (28.1-*ca.* 31.9); pectoral length 11.8-17.5 (*ca.* 13.0 and 17.1-20.5); ventral length 7.95-9.77 (9.1-*ca.* 11.5).

Apparently the only character in which Atlantic and Indian Ocean specimens differ is in the number of anal rays, 30-33 in the Atlantic, 25-30 in the Indian.

Photichthys Hutton 1872

Phosichthys Hutton, 1872, Cat. Fishes New Zealand, p. 55, type species *Phosichthys argenteus* Hutton, 1872, Cook Strait, New Zealand.

Photichthys Hutton, 1873, Trans. New Zealand Inst., **5:** 10 (emended spelling); Günther, 1887, Rep. Sci. Res. Voy. Challenger, Zool., **22:** 177; Goode and Bean, 1895, Ocean. Ichth., p. 104; Collett, 1896, Bull. Soc. Zool. France, **21:** 94; Barnard, 1925, Ann. So. Afr. Mus., **21:** 149; McCulloch, 1926, Biol. Res. Endeavour, **5:** 166; Norman, 1930, Discovery Rep., **2:** 292; Smith, 1949, Sea Fishes So. Afr., p. 104.

Generic characters. Eye normal, moderate or large. Snout about equal to diameter of orbit. Interorbital width at center of eye about equal to diameter of orbit. Mouth large, slightly oblique; toothed edges of premaxillary and maxillary straight; maxillary nearly reaching preopercle. Premaxillary about half as long as toothed portion of maxillary. Angle of preopercle slightly acute. Teeth of upper jaw uniserial, premaxillary with one or two longer teeth and a few small ones; maxillary teeth all rather short, unequal, curving slightly inward. Lower jaw with several widely spaced longer teeth (as long as large premaxillary teeth); smaller teeth between the long ones except anteriorly, where there is an outer row of small, inwardly curved teeth. Vomer with one or two teeth on each side. Palatines each with a long row of unequal teeth. Pterygoids toothless or each with a small patch of minute teeth posteriorly. Tongue with or without a few small teeth at tip. Gill rakers 11 + 4-5 = 15-16 on first arch. Spines on inner edge of first gill arch short (a little longer near angle), one or two minute spines below a few anteriorly. No pseudobranchiae. Scales present, very deciduous. Anus near anal fin, beneath twelfth to fourteenth VAV photophore. Head and trunk more than twice as long as tail. Origin of dorsal fin about in middle of body length. Origin of anal fin well behind end of dorsal fin. Ventral bases slightly in advance of dorsal origin. Adipose fin small, above middle or anterior portion of anal fin. ORB 2, one near lower anterior margin of

eye, the other below its posterior margin; anterior one larger. OP 3, upper one level with upper border of pupil; lower two on same level, behind end of maxillary, anterior one slightly larger. SO present. BR 17-18. No additional photophores on head. Body with two rows of serial photophores; photophores present on isthmus. IV 24-25, straight. VAV 15-17. AC 16-18, straight, five to seven of them behind anal fin. IC 57-58. OA 33-34, reaching above front of anal fin (about over third AC photophore). No additional photophores and no luminous tissue on body as far as known. Fin rays: dorsal 12-13, anal 23-26, pectoral 9, ventral 6-7. Branchiostegal rays 20-21, no spines at bases. Vertebrae 51, including hypural (counted from X-ray photograph of one specimen).

Remarks. Photichthys is closely related to *Woodsia* but differs in higher meristic counts, in having the gill rakers more developed, and in body proportions. The generic diagnosis is based on three specimens from New Zealand (p. 65) and also on published accounts. In the specimens examined the palatine teeth are unequal in size, some of the anterior ones are enlarged, the posterior ones are all small, and a few are curved. There are two small patches of minute pterygoid teeth and a few tiny teeth on the tongue.

The genus contains only one species, *P. argenteus* Hutton, which is known from New Zealand and in the South Atlantic from *ca.* 32° S., 8° W. to Cape Point, South Africa.

Gonostoma Rafinesque 1810

Gonostoma Rafinesque, *1810, Ind. Ittiol. Sicil., p. 64; type species *Gonostoma denudata* Rafinesque, 1810, Mediterranean; Bonaparte, *1841, Icon. Fauna Ital., **3:** Cuvier and Valenciennes, 1849, Hist. Nat. Poiss., **22:** 278; Günther, 1864, Cat. Fishes Brit. Mus., **5:** 391; 1887, Rep. Sci. Res. Voy. Challenger, Zool., **22:** 172 (part, *Cyclothone* in synonymy); Moreau, 1891, Hist. Nat. Poiss. France, Suppl., p. 78; Goode and Bean, 1895, Ocean. Ichth., p. 93 (part, not *G. brevidens*); Jordan and Evermann, 1896, Bull. U. S. Nat. Mus., **47:** 578 (part; not *G. brevidens*); Collett, 1896, Bull. Soc. Zool. France, **21:** 94; Brauer, 1906, Wiss. Ergebn. Deutschen Tiefsee Exp. Valdivia, **15** (1): 70; Weber and de Beaufort, 1913, Fishes Indo-Austr. Arch., **2:** 120; Barnard, 1925, Ann. So. Afr. Mus., **21:** 143; Norman, 1930, Discovery Rep., **2:**

* Starred references not seen.

281; Fowler, 1936, Bull. Amer. Mus. Nat. Hist., **70:** 229; Lozano Rey, 1947, Mem. R. Acad. Cien. Madrid, Ser. Cien. Nat., **11:** 158; Smith, 1949, Sea Fishes So. Afr., p. 104; Misra, 1953, Rec. Indian Mus., **50:** 396; Mead and Taylor, 1953, Jour. Fish. Res. Bd. Canada, **10:** 570.

Sigmops Gill 1883, Proc. U. S. Nat. Mus., **6:** 256; type species *S. stigmaticus* Gill, 1883, equals *Gonostoma elongatum* Günther.

Neostoma Vaillant, in Filhol, *1884, Nature, Paris, **558**; 1888, Exp. Sci. Trav. Talis., Poiss., pp. 96, 385; type species *N. bathyphilum* Vaillant, 1884, 1888; Collett, 1896, Bull. Soc. Zool. France, **21:** 95.

Cyclothone Goode and Bean 1895, Ocean. Ichth., p. 99 (part, *C. bathyphila, C. elongata*); Jordan and Evermann, 1896, Bull. U. S. Nat. Mus., **47:** 581 (part, *C. bathyphila, C. elongata*); Collett, 1896, Bull. Soc. Zool. France, **21:** 94 (part, *C. grandis* Collett); Alcock 1899, Descr. Cat. Indian Deep-sea Fishes, p. 139 (part, *C. elongata*); Fowler, 1936, Bull. Amer. Mus. Nat. Hist., **70:** 222 (part, *C. bathyphilum*).

Generic characters. Eye normal, moderate or small. Snout longer than or about equal to diameter of orbit. Interorbital width at center of eye longer than or about equal to diameter of orbit. Mouth large, oblique; toothed edge of premaxillary straight or slightly concave; toothed edge of maxillary convex or nearly straight, nearly reaching preopercle. Premaxillary less than half as long as toothed edge of maxillary. Angle of preopercle acute. Teeth of upper jaw uniserial, longer teeth with smaller ones in interspaces. Lower jaw with a row of teeth similar to those of upper jaw and, anteriorly only, a very short outer row. Vomer usually with 1-2 small teeth on each side (absent in *denudatum*). Palatines each with a single row of teeth. A patch of teeth on pterygoids on each side and usually a few additional teeth posteriorly on roof of mouth. Tongue with or without teeth. Gill rakers 10-17 + 5-11 = 15-27 on first arch. Spines on inner edge of first gill arch moderate or long, a row of prickles or minute spines below each one. No pseudobranchiae. Scales present or absent. Anus nearer anal origin than ventral bases. Head and trunk about the same length as, or longer than, tail. Dorsal origin about in middle of body length or behind it. Anal origin opposite or in advance of dorsal origin. Ventral fins well ahead of dorsal origin. Adipose fin present or absent. ORB 1 (obsolete in *bathyphilum*). OP 2 or 3, lower anterior one often absent or obscured by bone (all obsolete in *bathyphilum*). SO

* Starred references not seen.

present (except in *bathyphilum*). BR 9 (not always visible on *bathyphilum*). No other photophores on head, but luminous glands or tissue usually associated with some of the photophores. Body with two rows of serial photophores, but in *bathyphilum* and *gracile* the upper row irregular and placed relatively high on sides; no photophores on isthmus. IV 11-16, prepectoral organs irregular or arched upward. VAV 3-10. AC 15-23. IC 32-43. OA 11-21, extending beyond ventral bases, first one or two elevated (irregular in *bathyphilum* and *gracile*). Additional photophores sometimes present on body. Luminous tissue usually present in the procumbent caudal rays, either dorsally, ventrally, or both. Fin rays: dorsal 10-18, anal 21-31, pectoral 9-13, ventral 6-8. Branchiostegal rays 10-14, spines present at inner bases of most of them. Vertebrae 37-40.

Remarks. *Gonostoma* is closely related to *Cyclothone*, from which it differs externally principally in dentition. It is also similar to *Bonapartia* in many respects (dentition, positions of dorsal and anal fins, most meristic characters).

There is much more variation among the species of *Gonostoma* than is found in any other genus of the family with the exception of *Diplophos*, which has been divided into two subgenera. However, all species of *Gonostoma* are held together by rather striking similarities and a division, even into subgenera, is considered inadvisable. The inter-relationships of the species are not clear, with the exception that *denudatum* and *atlanticum* are closely related; and one or two common characters are at times shared by species which seem otherwise not to be closely related. For example, the anus is typically situated close to the anal fin (below or close behind the penultimate VAV photophore) but in both *gracile* and *ebelingi* it is more remote from the anal origin, although never, as far as known, nearer the ventral bases. Similarly, a relatively short tail has until recently been characteristic only of the closely related species *denudatum* and *atlanticum*, but the newly discovered *ebelingi* is also a short-tailed form.

In most gonostomatid genera the presence or absence of an adipose dorsal fin is a distinctive character, but in *Gonostoma* this fin may be well developed (*elongatum, bathyphilum, ebelingi*), small (*denudatum*), or absent (*atlanticum, gracile*). In species whose life-histories are known, the adipose appears

relatively late in the developmental period, whereas in other gonostomatid fishes with an adipose fin it is present in very early stages.

Gonostoma is unique in showing considerable variation in the arrangement of the photophores. In other gonostomatid genera the position of the light organs is relatively constant. The reduction in size and number of these organs in *bathyphilum* is correlated with the greater depth of habitat of this species, but the irregular placement of the OA in *bathyphilum* and in *gracile*, the additional row of photophores near the dorsal profile of *gracile*, and the many minute organs found on *elongatum*, and possibly also on *bathyphilum*, represent a departure from the usual generic limits. The recent discovery of a new species, *ebelingi*, with ten VAV and twenty-one OA, further emphasizes the variability found in the genus, which is otherwise characterized by a short ventral-anal space containing no more than five VAV, and by having only eleven to fifteen OA.

The amount of scalation present is uncertain as the scales are usually extremely deciduous. The body of *denudatum* is normally full scaled and that of *atlanticum* may be also. Scales have never been reported on any specimen of either *bathyphilum* or *gracile*, and only rarely on *elongatum*. The latter, however, has scales on at least some portions of the body, although they are very deciduous.

The following key will serve to distinguish the species of *Gonostoma* but is not necessarily phylogenetic.

Key to the species of the genus Gonostoma

1a. Anus well ahead of anal origin, sometimes almost midway between ventral bases and first anal ray. First 4-5 IV in an ascending line, 5th or 6th directly below 4th or 5th and level with those following it.

2a. Adipose fin present. Anal origin opposite or only slightly in advance of dorsal origin. Head and trunk noticeably longer than tail. VAV 9-10. OA 21, all but the first on the same level. No row of photophores near dorsal profile of body.

ebelingi, new species
Pacific

2b. Adipose fin absent. Anal origin noticeably in advance of dorsal origin. Head and trunk about same length as tail. VAV 3-5. OA 11-14, somewhat irregularly arranged. A row of widely separated photophores near dorsal profile of body.

gracile Günther 1878[1]
Pacific

1b. Anus close to anal origin. First 5-6 IV forming an upwardly arched arc, or reduced in number to 2 or 3 (***bathyphilum***).

3a. Photophores minute, obscure. ORB, OP and SO usually obsolete in adult. OA irregularly arranged, some rather high on sides. A few posterior pterygoid teeth much enlarged. Anal rays 21-24. IV 11-13. Gill rakers on first arch 15-17 + 9-11 = 24-27.

bathyphilum (Vaillant) 1888
Atlantic

3b. Photophores obvious, if not always conspicuous. ORB, OP and SO relatively well developed, a glandular mass present below upper OP. OA mostly on a single level low on sides, only the first one or two elevated. Pterygoid teeth all small, or a few of the posterior ones slightly enlarged. Anal rays 27-31. IV 14-16. Gill rakers on first arch 10-12 + 5-9 = 15-21.

4a. Body and head with numerous minute photophores (not always evident). A mass of glandular tissue associated with each SO and ORB. Gill rakers 10-12 + 7-9 = 18-21. Head and trunk almost same length as tail. Interspace teeth in jaws not especially close-set.

elongatum Günther 1878
Atlantic, Pacific, Indian

4b. No minute photophores on body or head. No glandular masses associated with ORB or SO (but a small silvery reflector present behind ORB). Gill rakers 10-11 + 5-6 = 15-17. Head and trunk noticeably longer than tail. Interspace teeth in maxillary close-set and about equal in size.

5a. Adipose fin present. Teeth absent on vomer, present on tongue centrally. First two AC photophores above, second two below remaining AC. Gill rakers 10 + 5 = 15.

denudatum Rafinesque 1810
eastern Atlantic, Mediterranean

[1]See Matsubara (1938, p. 41, fig. 3); Mead and Taylor (1953, p. 568). Synonym: *Gonostoma vitiazi* Rass (1950, p. 1041, fig.).

5b. No adipose fin. Teeth present on vomer, absent on tongue centrally.[1] First one or two AC photophores slightly elevated, others on one level. Gill rakers 11 + 5-6 = 16-17.

atlanticum Norman 1930
Atlantic, Pacific

Gonostoma atlanticum Norman 1930

Gonostoma denudatum atlanticum Norman 1930, Discovery Rep., **2:** 283; Atlantic, 8° 12′ N., 18° 49′ W. to 0° 56′ S., 14° 08′ 30″ W., type locality not designated.

Gonostoma denudatum Goode and Bean 1895, Ocean. Ichth., p. 98 (part, off northern Florida); Jordan and Evermann, 1896, Bull. U. S. Nat. Mus., **47:** 579 (part); Murray and Hjort, 1912, Depths of Ocean, pp. 604, 605, 612, 744, fig. 456 (middle and eastern Atlantic); Jespersen and Täning, 1926, Rep. Danish Oceanogr. Exp. 1908-1910, **2,** (A 12): 4 (part), fig. 2 (part) (Atlantic, *ca.* 12° N., 35° W.); Grey, 1956, Fieldiana, Zool., **36:** 119 (part); Koefoed, 1958, Rep. Sci. Res. M. Sars No. Atl. Deep-sea Exp. 1910, **4,** (2), (6): 13 (part?).

The following specimens have been examined.

Atlantic off Florida: One, standard length 53 mm., U.S.N.M. No. 44582, *Albatross* Station 2665, 29° 47′ N., 80° 05′ 45″ W., 4 May 1886, 263 fathoms (480 meters), 45.2°F. at bottom (reported by Goode and Bean, 1895).

Atlantic off South Carolina, one specimen, 63.5 mm., *Combat* Station 296, 32° 40′ N., 77° 40′ W., 21 April 1957, 220 fathoms (403 meters).

Western Pacific: Two, standard length *ca.* 55 and 46 mm., SIO 56-133, Marshall Island area, 12° 27′ N., 164° 30′ E. to 12° 38.8′ N., 165° 09′ E., 15-16 June 1956, *Horizon*, 10′ midwater trawl, 0-1150 fathoms (0-2104 meters).

Counts and proportions of these specimens are shown in Table 5.

Head and body considerably compressed. Skin entirely or almost entirely lost, no remains of scales or scale pockets except in smaller Pacific specimen, where there is evidence on the tail that scales were once present. Head and trunk longer than tail. No adipose fin. Anus below fourth VAV photophore, near anal origin. Spines on inner edge of first gill arch short.

[1]One minute tooth found on each lateral edge, posteriorly, in one specimen of *atlanticum*.

Edge of premaxillary straight, toothed edge of maxillary convex. Maxillary with a series of 9-10 longer teeth and 4-8 small, subequal, close-set teeth in each interspace except posteriorly; last four maxillary teeth slightly enlarged and without interspace teeth. Teeth of lower jaw similar but interspace teeth less close-set and slightly larger than those of upper jaw; anteriorly two to four small outer teeth and a few minute ones. Vomer with two very small teeth on each side, difficult to distinguish. Atlantic specimens with three or four teeth on each palatine, increasing in size posteriorly and followed by a few minute teeth; Pacific specimens with three teeth on each palatine, the second one largest. Pterygoids with a patch of very small teeth; none enlarged; none visible posteriorly in smaller Atlantic specimen, a few present in larger Atlantic specimen and in Pacific specimens. Tongue toothless except in larger Atlantic specimen, which has 1-2 minute teeth on each lateral edge posteriorly.

No gland tissue associated with ORB or SO, but a small, narrow silvery reflector present behind ORB. SO minute. OP 3, glandular material present below upper one, which is level with center of eye; lower two about level with end of maxillary, posterior one larger and slightly higher than anterior one. Photophores on body without evident glandular areas. Five prepectoral IV photophores forming a very low arc; first one or two AC slightly elevated, others on one level; OA all or nearly all lost in Atlantic specimens and in larger Pacific specimen, last three (behind ventrals) remaining on larger Atlantic specimen, in a slightly ascending line, ending over space between third and fourth VAV; smaller Pacific fish with 13 OA, the first elevated, the last three (behind ventrals) in an ascending line, ending above space between third and fourth VAV. Two infracaudal glands present in Pacific specimens, and larger Atlantic specimen with a small mass of tissue below last AC photophore, probably somewhat more extensive in life. No supracaudals (lost?).

Color of smaller Atlantic specimen pale yellowish brown after long preservation, peritoneum darker, inside of mouth and opercles pale. Skin remaining on larger Atlantic specimen blackish; end of peduncle blackish; fin rays colorless, base of each

dorsal and anal ray black, peritoneum black; inside of mouth with some black puncticulations; linings of gill covers and inner half of branchiostegal membranes black. Skin remaining on Pacific specimens blackish brown, cheeks silvery with black puncticulations, peritoneum and linings of opercles black, inside of mouth pale anteriorly and dusky posteriorly.

G. atlanticum was originally distinguished by Norman as a subspecies of *G. denudatum* Rafinesque on the basis of differences in the arrangement of the AC photophores and the number of gill rakers (usually 10 + 5 in *denudatum,* 11 + 6 in *atlanticum*). *G. atlanticum* is here given specific rank. It has been found to differ further from *denudatum* in lacking an adipose fin and tongue teeth, in being more slender bodied, in having a longer dorsal base, and in being a smaller species. Dr. D. W. Tucker has written (*in litt.,* 1958) that none of the specimens of the type lot, in the British Museum, has an adipose fin; and that a specimen 48 mm. in standard length, from *Discovery* Station 296, is a female with ovaries in which the eggs are readily distinguished, although not fully developed. The *Albatross* specimen has not been examined internally but the *Combat* specimen and both Pacific specimens reported here are also females with immature eggs in the ovaries.

G. atlanticum is known from the central and eastern Atlantic, from the latitude of the Azores (*ca.* 39° N.) south to 0° 56′ S., 14° 08′ 30″ W., off the African coast; and in the western Atlantic off the southern United States coast. In the Pacific it is known so far only from the two specimens reported here from the Marshall Island area. Norman's statement (1930, p. 283) that Goode and Bean reported *G. denudatum* off the coast of California was an error.

Goode and Bean (1895, p. 98) stated that *G. denudatum* was trawled off New England by the *Fish Hawk* in 1881, but no further data was given. In the same work, on page 102, these authors listed, under the name *Cyclothone elongata,* a specimen from *Fish Hawk* Station 1048, which was made on October 10, 1881. This specimen, U.S.N.M. No. 29069, cannot now be located but there is in existence an unpublished drawing of it, labeled "*Gonostoma denudata,* U.S.N.M. 29069, *Fish Hawk* Station 1048, H. L. Todd, del., Jan. 1882." The drawing undoubtedly

represents *G. elongatum* Günther and the record of *denudatum* from New England was perhaps an error based on an original mis-identification of this specimen.

Gonostoma ebelingi, new species

Holotype. Standard length 97 mm. Scripps Inst. of Oceanography No. SIO-56-133, Marshall Island area, 12° 27′ N., 164° 30′ E. to 12° 38.8′ N., 165° 09′ E., 10′ mid-water trawl, 1150-0 fathoms (2104-0 meters), *Horizon*, 15-16 June 1956, time 1725-0830.

Paratype. Standard length *ca.* 87 mm. Scripps Inst. of Oceanography No. SIO-56-127, same locality, 13° 03′ N., 166° 04′ E. to 13° 03′ N., 166° 32′ E., 10′ mid-water trawl, 400-0 fathoms (732-0 meters), 23-24 June 1956, time 2020-0700.

Description. Counts and proportions in parentheses refer to the paratype. Dorsal 13 (12). Anal 28 (28). Pectoral 9 (9). Ventral 8. Branchiostegal rays 13 (13), six (eight) of them with short spines at bases. Gill rakers 12 + 8 (11 + 8) on first arch. Number of vertebrae unknown.

Measurements in per cent of standard length, 97 (*ca.* 87) mm.: depth *ca.* 11.85; head *ca.* 22.7; snout 3.61; orbit 2.68; interorbital width at center of eye *ca.* 3.61 (*ca.* 3.45); upper jaw 18.05; premaxillary 5.15; toothed edge of maxillary 12.9; lower jaw *ca.* 18.6; tip of snout to dorsal origin 58.3 (*ca.* 59.8), to anal origin 58.3 (*ca.* 57.5), to ventral bases *ca.* 39.7 (*ca.* 40.2); distance between first anal ray and base of middle caudal rays 40.2 (*ca.* 38.8), last anal ray and base of middle caudal rays 8.76 (*ca.* 8.05), last dorsal ray and base of middle caudal rays 27.8 (*ca.* 27.0-27.6), last dorsal ray and adipose fin 7.74 (*ca.* 8.6), ventral base and anal origin *ca.* 18.05 (*ca.* 16.7); least depth of caudal peduncle 4.13 (*ca.* 4.0); dorsal base 12.4 (*ca.* 12.65); anal base 31.4 (*ca.* 33.3); ventral length 8.76.

Head and body considerably compressed. Neither specimen in perfect condition, head and body just behind head damaged in paratype, pectoral fins broken in both specimens, skin almost entirely lost in paratype, and with it most of the photophores of the lateral row. No scales or scale pockets visible. Head and trunk noticeably longer than tail. Anal origin behind middle of body length, below or slightly in advance of dorsal origin.

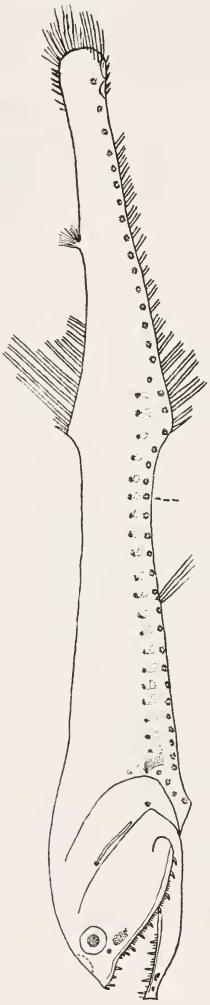

Figure 3. *Gonostoma chelingi*, new species. Holotype, Scripps Institution of Oceanography No. 810-56-133. Standard length 97 mm.

Adipose fin moderate, short-based, situated above end of anal fin. Pectorals broken. Ventrals reaching fifth VAV photophore in holotype, broken in paratype. Anus beneath sixth VAV photophore, well ahead of anal origin.

Edge of premaxillary straight, toothed edge of maxillary convex. Eye moderate. Angle of preopercle acute. Spines on inner edge of first gill arch well developed but not quite half as long as longest gill raker.

Premaxillary teeth of holotype all broken off short; upper jaw lacking in paratype except the premaxillary of one side, this bearing seven teeth, one fang-like, the others smaller and of varying lengths. Longer teeth of maxillary mostly broken; interspace teeth numbering six to ten, small, about equal in size, evenly spaced and rather close together. Lower jaw with about nine long teeth; four to six smaller teeth in each interspace, unequal in size and not close together; anteriorly probably three or four teeth in outer row, mostly broken. Vomer with one small tooth on each side. Holotype with a row of about twelve small, well separated teeth on each palatine, smaller posteriorly; palatine bones of paratype broken, remaining teeth smaller than those of holotype. Pterygoid teeth all small, sparse, in a small patch anteriorly; posteriorly a few scattered teeth. Tongue without teeth.

Photophores moderate. ORB with a relatively large gland behind it, SO with a small one. OP 2, upper one small, level with center of eye, a narrow streak of glandular material below it; lower posterior one larger, level with end of maxillary; lower anterior one absent. BR 9. No separate glandular areas associated with ventral row of photophores on body; a small mass of gland tissue below each photophore of the lateral row. IV 15, first four rising toward pectoral base, fifth directly below fourth and on the same level as the remaining ten. VAV 10, continuous with AC. AC 19, all on one level except the third, which is slightly elevated; possibly an additional raised organ at base of caudal fin. IC 44. OA 21, the first elevated, others straight, reaching a vertical from sixth anal ray; almost all missing in paratype. Two infracaudal glands, no supracaudal (possibly lost).

Color brownish black, abdomen and branchiostegal membrane black. Traces of dark metallic iridescence on both head and body. Inside of mouth and gill covers dark.

Remarks. G. ebelingi is distinct from all other species of the genus *Gonostoma* in having a much greater distance between ventral and anal fins, a correspondingly larger number of VAV photophores, and more OA photophores. Within the genus its relationships are obscure. Only in *gracile* is the anus situated so far in advance of the anal origin and these two species are also similar in coloration, in the arrangement of the prepectoral IV photophores, and in having the OA extend beyond the anal origin. On the other hand, *ebelingi* is like *denudatum* and *atlanticum* in the relative proportions of trunk and tail, and in having the small interspace teeth of the maxillary close-set and more or less equal in size.

The species has been named for Dr. Alfred W. Ebeling, of Scripps Institution of Oceanography, in appreciation of his interest and assistance during the course of this study.

Danaphos Bruun 1931

Danaphos Bruun 1931, Vidensk. Medd. Dansk Naturh. Foren., **92:** 286.

Generic characters. Eye tubular, directed obliquely upward. Snout slightly shorter than orbit. Interorbital width at center of eye much less than diameter of orbit. Mouth moderate, nearly vertical; maxillary abruptly horizontal, its toothed edge convex, reaching or nearly reaching a vertical from posterior margin of eye. Premaxillary more than half as long as toothed edge of maxillary. Angle of preopercle slightly obtuse or nearly vertical. Teeth of upper jaw uniserial, minute on premaxillary; slightly longer on maxillary, very slender, much shorter teeth between longer ones. Teeth of lower jaw minute, seen under high power to be in two or more rows in anterior half of jaw, uniserial and slightly larger posteriorly. No teeth on vomer, palatines, pterygoids or tongue. Gill rakers 11-13 + 2 = 13-15 on first arch. Spines on inner edge of first gill arch rudimentary. Pseudobranchiae present but very small and fragile. Scales present but very deciduous. Anus a little nearer anal origin than ventral bases, beneath third or fourth VAV photophore. Head and trunk slightly shorter than tail. Origin of dorsal fin well ahead of

middle of body length. Origin of anal fin behind end of dorsal fin. Ventral bases beneath dorsal fin. Adipose fin present or absent; if present, small and poorly developed. ORB 1, in front of center of eye. OP 2 or 3, upper one not always present; lower two behind end of maxillary, about equal in size or the anterior one slightly larger. SO absent. BR (6). No additional photophores on head. Body with two rows of serial photophores; photophores present on isthmus. IV (3) + (4) + 1 + (2) + 8 = 18. VAV usually (5), (4) in one specimen. AC (3) + 14-18 + (4)[1] + 1 = 22-26, straight. IC 45-49. OA (2) + 4-5 = 6-7. No additional photophores and no luminous tissue on body as far as known. Fin rays: dorsal 6, anal 24-25, pectoral (12?) 13-14, ventral 6. Branchiostegal rays 9-10, bases prominent on inner edge and occasionally with minute spines. Vertebrae 38, counted on X-ray photograph of one specimen.

Remarks. As suggested by Bruun (1931, p. 287) *Maurolicus oculatus* Garman (1899, p. 241, pl. 53, fig. 3) belongs in the genus *Danaphos*. New material of this species from the eastern and northern Pacific has shown that *Danaphos astcroscopus* Bruun 1931, known from the tropical Indian Ocean and from the central and western parts of the Pacific, is probably a synonym of *D. oculatus*. The only apparent distinctions between the two species are the presence, in *astcroscopus*, of a small and poorly developed adipose fin, which could not be found on any of the specimens examined; and the fact that *astcroscopus* was said to have an upper OP photophore, which is not present on any of the specimens seen. Many of the latter are mature, or nearly so, both sexes being represented but females predominating. The generic description was based on the following specimens of *D. oculatus* from the collection of Scripps Institution of Oceanography.

Eastern Pacific: Two, standard length 33 and 36 mm., SIO 54-98, 26° 23.5′ N., 123° 14′ W., to 26° 53.5′ N., 123° 22′ W., 25-26 June 1954, 10′ midwater trawl, 1578 fathoms (2886 meters); five, standard length 28-38 mm., SIO 57-43, 28° 52′ N., 118° 12.5′ W. to 28° 59.5′ N., 118° 09′ W., 10 February 1957, 380-0 fathoms (695-0 meters); eleven, standard length 32-39 mm., SIO 57-206, 28° 34.5′ N., 126° 52′ W. to 28° 47.9′ N., 126° 24′ W., 20-21 June

[1]One specimen with (3) on left side, (4) on right side.

1955, 10′ midwater trawl, 0-675 meters; sixteen, all fragmentary, SIO 57-88, 28° 46′ N., 126° 33′ W. to 28° 17′ N., 126° 45′ W., 22 May 1955, 10′ midwater trawl, 0-348 fathoms (0-636 meters); two, standard length *ca.* 29 and 26.5 mm., H-51-188, 33° 09′ N., 118° 01′ W. to 32° 57′ N., 117° 48′ 30″ W., 22 May 1951, 200 fathoms over 490-500 fathoms (360 meters over 896-1006 meters).

North Pacific: Nineteen, standard length 21-39 mm., H 51-354, 40° 23′ N., 139° 23′ W., 5 August 1951, 10′ midwater trawl, 400-650 meters; thirteen, standard length 21-43 mm., H 51-358, 40° 35′ N., 147° 55′ W., 10 August 1951, 10′ midwater trawl, 350-600 meters; fifteen, standard length 27-*ca.* 45 mm., H 51-359, 41° 42′ N., 150° W., 11 August 1951, 600-800 meters.

Neophos Myers

Neophos Myers, 1932, Copeia, p. 61.

Generic characters. Eye normal, moderate or large. Snout shorter than orbit. Interorbital width at center of eye less than diameter of orbit. Mouth large, oblique; premaxillary nearly vertical, its toothed edge straight; toothed edge of maxillary curving abruptly downward from juncture with premaxillary, becoming almost straight posteriorly, nearly reaching preoperele. Premaxillary about half as long as toothed portion of maxillary. Angle of preoperele vertical. Teeth all minute, irregular on premaxillary, uniserial and with some slightly longer teeth on maxillary; teeth of lower jaw uniserial but with a short outer row of minute teeth anteriorly. Vomer with a few teeth on each side. Palatines each with a few teeth. No teeth on pterygoids or tongue. Gill rakers about 13-14 + 5 = 18-19 on first arch. No spines on inner edge of first gill arch, a few minute ones on second arch. Pseudobranchiae present. No evidence of scales. Anus close to anal origin, beneath last VAV photophore. Head and trunk shorter than tail. Origin of dorsal fin about in middle of body length. Anal origin well ahead of dorsal origin. Ventral bases well ahead of dorsal origin. No adipose fin. ORB 1, in front of eye. OP 3, upper one elongate, about level with middle of eye; lower two on the same level behind end of maxillary, the posterior one larger. SO present. BR (6). No additional photophores on head. Body with one row of serial photophores and a single organ representing the lateral row; photophores

present on isthmus. IV 1 + (2) + (3), on isthmus, + 11 = 17. VAV 1 + (3) + 1 = 5. AC 13, all single, straight, two of them behind anal fin. IC 35. OA 1, above pectoral base. No additional photophores and no luminous tissue on body as far as known. Fin rays: dorsal 8, anal 38, pectoral 13, ventral 7. Branchiostegal rays 7 or 8, no spines at bases. Number of vertebrae unknown.

Remarks. The type and only known specimen of *Neophos nexilis* Myers (1932, p. 61) has been examined. The genus is closely related to *Thorophos* Bruun and is possibly synonymous with it, but comparative material is necessary to establish their identity.

LITERATURE CITED

Abe, T.

1958. *Diplophos orientalis* Matsubara. *In* I. Tomiyama and T. Abe, Figures and Descriptions of the fishes of Japan, **59:** 1221-1247, pls. 236-238. Tokyo.

Bertin, L.

1939. Révision des Stomiatiformes (Téleostéens Isospondyles) du Muséum. Bull. Mus. Hist. Nat. Paris, **11:** 378-382.

Brauer, A.

1906. Die Tiefseefische. 1. Systematischer Teil. Wiss. Ergebn. Deutschen Tiefsee Exp. Valdivia, **15** (1): 1-432, 18 pls., 176 text figs. Jena.

1908. Die Tiefseefische. 2. Anatomischer Teil. Wiss. Ergebn. Deutschen Tiefsee Exp. Valdivia, **15** (2): 1-266, 42 pls., 187 text figs. Jena.

Bruun, A. F.

1931. On some new fishes of the family Gonostomatidae. Vidensk. Medd. Dansk Naturh. Foren., **92:** 285-291, pl. 8.

1950. General Report. Atlantide Rep., **1:** 7-28, 17 figs.

Garman, S.

1899. Reports on an exploration off the west coast of Mexico, Central and South America, and off the Galapagos Islands . . . 26. The fishes. Mem. Mus. Comp. Zool., **24:** 1-431, 85 pls.

Gilbert, C. H. and F. Cramer

1896. Report on the fishes dredged in deep water near the Hawaiian Islands, with descriptions and figures of twenty-three new species. Proc. U. S. Nat. Mus., **19:** 403-435, pls. 36-48.

Gilchrist, J. D. F. and C. von Bonde

1924. Deep-sea fishes procured by the S.S. "Pickle." Rep. Fish. Mar. Biol. Surv. So. Africa, **3** (7): 1-24, 6 pls.

Goode, G. B. and T. H. Bean

1895. Oceanic Ichthyology. Smithsonian Contr. Knowl., **981**, **982**, xxxv + 553 pp., 417 figs.

Grey, M.

1955. Notes on a collection of Bermuda deep sea fishes. Fieldiana, Zool., **37**: 265-302, figs. 45-56.

1959. Three new genera and one new species of the family Gonostomatidae. Bull. Mus. Comp. Zool., **121**: 167-184, 3 figs.

Günther, A.

1889. Report on the pelagic fishes. Rep. Sci Res. Voy. Challenger, Zool., **31**: 1-47, 6 pls.

Herre, A. W. and E. S. Herald

1950. Noteworthy additions to the Philippine fish fauna, with descriptions of a new genus and species. Philip. Jour. Sci., **79**: 309-340, figs. 1-12.

Jespersen, P.

1933. *Valenciennellus tripunctulatus*. Faune Ichth. Atl. Nord, **14**, fig.

Jespersen, P. and A. V. Tåning

1919. Some Mediterranean and Atlantic Sternoptychidae. Vidensk. Medd. Dansk Naturh. Foren., **70**: 215-226, pl. 17.

Johnson, J. Y.

1890. On some new species of fishes from Madeira. Proc. Zool. Soc. London, 1890: 452-459.

Koefoed, E.

1958. Isospondyli. 2. Heterophotodermi, 1, from the "Michael Sars" North Atlantic Deep-sea Expedition 1910, with addenda et corrigenda to Isospondyli 1. Rep. Sci. Res. M. Sars No. Atl. Deep-sea Exp. 1910, **4** (2), (6): 1-18, 1 pl., 2 text figs.

Koumans, F. P.

1953. Biological results of the Snellius Expedition. XVI. The Pisces and Leptocardii. Temminckia, **9**: 177-275, 2 figs.

Lloyd, R. E.

1909. A description of the deep-sea fish caught by R.I.M.S. Ship "Investigator." Mem. Indian Mus., **2**: 139-180, pls. 44-50.

LONGLEY, W. H. and S. F. HILDEBRAND
1941. Systematic catalogue of the fishes of Tortugas, Florida. Publ. Carnegie Inst. Washington, No. **535**. xiii + 331 pp., 34 pls.

LÜTKEN, CHR. FR.
1892. Bidrag til Kundskab om det aabne Havs Laxesild eller Scopeliner, med et Tillaeg om en anden pelagisk Fiskeslaegt. Vidensk. Selsk. Skr., (6) **7** (6): 223-297, pls. 1-3, text figs.

MCARDLE, A. F.
1901. Natural history notes from the Royal Indian Marine Survey Ship "Investigator" . . . Ser. 3, No. 5. An account of the trawling operations during the surveying season of 1900-1901. Ann. Mag. Nat. Hist., (7) **8**: 517-526.

MCCULLOCH, A. R.
1926. Report on some fishes obtained by the F.I.S. "Endeavour" on the coasts of Queensland, New South Wales, Victoria, Tasmania, south and southwestern Australia. Part 5. Biol. Res. Endeavour, **5**: 157-216, pls. 43-56, text figs. 1-4.

MATSUBARA, K.
1938. On some stomiatoid fishes from Kumano-Nada. Jour. Imp. Fish. Inst. Tokyo, **33**: 37-52, 8 figs.

1940. Studies on the deep-sea fishes of Japan. 13. On Prof. Nakazawa's collection of fishes referable to Isospondyli, Iniomi, and Allotriognathi. Suisan Kenkiu-Shi, **35**: 314-19.
1941. Studies on the deep-sea fishes of Japan. 13. On Prof. Nakazawa's collection of fishes referable to Isospondyli, Iniomi, and Allotriognathi. Suisan Kenkiu-Shi, **36**: 1-10, 1 fig.
1943. Ichthyological annotations from the depth of the Sea of Japan. Jour. Sigen. Kenk., **1**: 37-81, pl. 1, text figs. 1-24.

MAUL, G. E.
1948. Monografia dos peixes do Museu Municipal do Funchal. Ordem Isospondyli. Bol. Mus. Mun. Funchal, **3** (5): 5-41, figs. 1-16.
1952. Additions to previously revised families. Bol. Mus. Mun. Funchal, **6** (16): 51-62, figs. 13-17.

MEAD, G. W. and F. H. C. TAYLOR
1953. A collection of oceanic fishes from off northeastern Japan. Jour. Fish. Res. Bd. Canada, **10**: 560-582, 8 figs.

MYERS, G. S.
1932. A new gonostomatid fish, *Neophos nexilis*, from the Philippines. Copeia, 1932: 61.

NORMAN, J. R.
1930. Oceanic fishes and flatfishes collected in 1925-1927. Discovery Rep., **2**: 261-370, pl. 2, 47 text figs.
1939. Fishes. Sci. Rep. John Murray Exp. 1933-34, **7** (1): 1-116, 41 figs.

PARR, A. E.
1931. Deepsea fishes from off the western coast of North and Central America. Bull. Bingham Oceanogr. Coll., **2** (4): 1-53, figs. 1-18.
1937. Concluding report on fishes. With species index for articles 1-7 (Fishes of the Third Oceanographic Expedition of the *Pawnee*). Bull. Bingham Oceanogr. Coll., **3** (7): 1-79, 22 figs.

POLL, M.
1953. Poissons, Téleostéens Malacopterygiens. Rés. Sci. Exp. Océanogr. Belge (1948-1949), **4** (2), (3): 1-258, 8 pls., 104 text figs.

RASS, T. S.
1950. A new Pacific Ocean deep-water fish, *Gonostoma vitiazi*, nova species (Pisces, Gonostomatidae). Doklady Akad. Nauk SSSR, **74**: 1041-1043, fig.

RECHNITZER, A. B. and J. BÖHLKE
1958. *Ichthyococcus irregularis*, a new gonostomatine fish from the eastern Pacific. Copeia, 1958: 10-15, pls. 1, 2, text figs. 1-3.

SEALE, A.
1935. The Templeton Crocker Expedition to western Polynesian and Melanesian islands, 1933. No. 27. Fishes. Proc. California Acad. Sci., **21**: 337-78, 3 pls.

SMITH, J. L. B.
1949. The sea fishes of southern Africa. Capetown, 550 pp., 1100 figs.

SPRINGER, S. and H. R. BULLIS, JR.
1956. Collections by the *Oregon* in the Gulf of Mexico. Spec. Sci. Rep U. S. Dept. Int., Fish., **196**: 1-134.

WELSH, W. W.
1923. Seven new species of fish of the order Malacopterygii. Proc. U. S. Nat. Mus., **62**: 1-11, figs. 1-10.

Table 1.

Counts and proportions of Atlantic specimens of *Diplophos taenia*, taken from the literature where indicated.

	Lütken, 1892, p. 278	Brauer, 1906, p. 89	USNM No. 100525	USNM No. 100616	Lütken, 1892, p. 279
Locality	10° N., 12° and 25° W.	*ca.* 5° N., 13° W.	*ca.* 30° N., 66° W.	*ca.* 25° N., 77° W.	20° N., 50° W.
Dorsal rays	*ca.* 9	11	11	10	9
Anal rays	*ca.* 43	61	68	68	*ca.* 60
Pectoral rays	*ca.* 8	8	—	8-9	10
Ventral rays	*ca.* 8	8	—	7	8
Gill rakers on first arch	—	—	7 + 3	8 + 3	—
BR	—	15-16[2]	12-13	13-14	11-12[3]
IV	49	44	47	47	44
VAV	16	16	17	16	17
AC	43 + 2	43 + 2	47 + 2	46 + 2-3	47 + 2
IC	110	105	113	111-112	110
OA	*ca.* 72	70	73	71	*ca.* 68?
Lat. line	*ca.* 90	91	—	98	—
Standard length	41[1]	59	66	74	85
			Per cent of standard length		
Depth	7.3	10.2	8.2	8.25	8.25
Head	15.8	17.0	16.7	14.8	14.1
Snout	—	5.1	4.1	3.9	—
Orbit	—	3.4	2.4	2.3	2.35
Upper jaw	—	—	11.1	10.4	—
Interorbital width at center of eye	—	3.4	2.7	2.3	—
Tip of snout to:					
dorsal origin	48.8	47.5	45.5	46.0	47.0
anal origin	51.2	51.0	50.0	48.6	49.5
ventral bases	39.0	38.1	36.4	36.5	36.5
Anal origin to caudal base	—	—	50.5	52.9	—
Dorsal base	—	4.75	*ca.* 3.03	4.6	—
Anal base	—	45.0	50.0	50.7	—
Least depth of caudal peduncle	—	3.4	1.96	2.03	—

[1]Possibly total length. [2]See p. 78. [3]Counted on figure 2 of Plate 2.

Table 2.

Counts and proportions of Pacific specimens of *Diplophos*, taken from the literature where indicated.

	pacificus Günther, 1889, type	SIO 56-127	*"taenia"* Herre and Herald, 1950	*proximus* Parr, 1931, type	*Diplophos* sp., Scripps Inst. of Oceanogr.	*orientalis* Matsubara, 1940, type	*orientalis*, Abe, 1958
Locality	Mid-Pacific	Marshall Ids.	Sulu Sea	Eastern Pac.	Eastern Pac.	Japan	Japan
Standard length	37	*ca.* 40	34-41[3]	82+[4]	89-100	179.8	177
Dorsal rays	12	11	10-11	10	9-10	12	12
Anal rays	53	51?	59-61	58	55-60	63	*ca.* 63
Pectoral rays	9	9	9	9	9	10	10
Ventral rays	7	—	—	8	7-8	8	8
Gill rakers on first arch	—	—	—	9+?	9+3	9+3	9+3
BR	—	12	—	11	10-11[5]	—	11
IV	—	*ca.* 43	—	41	41-42	40	40
VAV	—	15	—	13	14-15	15	14
AC	—	44 + 2	—	41+2	40-42+2	39+4	39+3[7]
IC	—	*ca.* 104	97-103	95+	98-102	98	96+
OA	—	67	66-69	77-78	60-84	87	63+[8]
Lateral line	41[1]	89[2]	89-92	*ca.* 80	86[6]	86	67+(89?)[9]
			Per cent of standard length				
Depth	—	*ca.* 8.75	—	10.5	9.5-10.5	12.3	12.1
Head	—	*ca.* 16.25	—	16.5	18.0-18.1	16.8	17.2
Snout	—	*ca.* 5.0	—	4.5	3.5-4.1	3.9	4.4
Orbit	—	*ca.* 2.5	—	3.5	3.0-3.6	3.8	3.5
Interorbital width at center of eye	—	*ca.* 2.5	—	3.0	3.0-3.1	3.25	3.8
Upper jaw	—	*ca.* 12.5	—	11.5	11.4-11.5	11.7	12.1
Tip of snout to:							
dorsal origin	—	*ca.* 43.7	—	48.0	46.5-47.6	45.5	46.3
anal origin	—	*ca.* 47.5	—	50.0	50.8-51.0	—	—
ventral bases	—	*ca.* 37.5	—	37.0	36.5-38.4	—	37.9
Anal origin to caudal base	—	*ca.* 47.5	—	—	49.2-50.0	48.4	47.6
Dorsal base	—	—	—	—	4.6-5.0	5.85	6.2
Anal base	—	—	—	—	45.0-46.0	44.0	43.5
Least depth of caudal peduncle	—	—	—	—	2.0-2.1	2.78	3.1

[1]From figure. [2]To end of anal fin. [3]Total length. [4]Tip of tail lacking. [5]Also 1-3 minute photophores. [6]One specimen only. [7]One or two possibly lost. [8]Probably lost on latter half of tail. [9]Judging from figure, probably orlginally *ca.* 89, including those now lost.

Table 3.

Counts and proportions of *Yarrella blackfordi* and *Yarrella argenteola*.

	blackfordi	*argenteola*
Standard length, mm.	170-261	125-133
Dorsal rays	14-16	14
Anal rays	29-31	28-29
Pectoral rays	8-9	9
Ventral rays	7	7
Branchiostegal rays	14-16	13
Gill rakers on first arch	12-13+6-7=18-20	15-16+6=21-22
Vertebrae (from X-ray photographs)	54	45
BR	12-13	11-12
IV	9+3-4+11-12=23-25	9+3+11-12=23-24
VAV	12	9-10
AC	25-27	20-21
IC	61-63	52-53
	Per cent of standard length	
Depth	11.4-14.3	15.0-15.1
Head	20.5-23.8	22.5
Snout	4.4-5.4	5.6-6.0
Orbit	2.47-3.25	4.0-4.5
Interorbital width at center of eye	5.0-5.75	5.2
Upper jaw	15.2-17.7	16.5-17.2
Premaxillary	8.4-10.0	8.6-9.2
Toothed portion of maxillary	6.6-7.65	7.9-8.0
Tip of snout to:		
dorsal origin	49.5-51.7	54.0-54.2
anal origin	56.1-58.5	58.5-59.0
ventral base	37.2-40.1	40.1-40.8
Ventral base to anal origin	16.4-18.0	17.6-18.5
Anal origin to base of middle caudal rays	41.9-45.4	40.5-41.4
End of anal to base of middle caudal rays	15.5-18.6 (20.2)	13.9-14.0
End of dorsal to base of middle caudal rays	35.0-35.8	31.6
Dorsal base	11.3-12.6	14.0-15.0
Anal base	(21.4) 24.3-26.7	26.8-27.0
Least depth of caudal peduncle	6.4-7.3	6.4

Table 4.

Counts and proportions of *Triplophos hemingi*, taken from the literature where indicated.

	McArdle, 1901 Lloyd, 1909 Norman, 1930	Brauer, 1906	Poll, 1953	Western Atlantic specimens
Locality	Bay of Bengal	South of Ceylon	West Africa, 5°-11° S.	Caribbean and Surinam
Standard length	205 and ?	144	60-161	106-176
Dorsal rays	10	10	10-11	10-11
Anal rays	57-61	57	54-56	57-63
Pectoral rays	10-11	10	—	9-10
Ventral rays	6 (9?)	6	—	6-7
Branchiostegal rays	14	17	—	11-13
Gill rakers on first arch	—	—	—	14-16+9
BR	—	13	—	8-10
IV	29-30	30	—	24-25
VAV	5	5	5-7	7
AC	35-36	41	—	37-39
IC	69-71	76	—	68-70
	Per cent of standard length			
Depth	—	12.8	—	*ca.* 12.0-15.0
Head	—	14.6	—	*ca.* 15.0-17.5
Snout	—	1.39	—	*ca.* 1.7-2.8
Orbit	—	2.43	—	2.4-3.4
Interorbital width at center of eye	—	2.78	—	2.3-2.9
Tip of snout to:				
dorsal origin	—	27.8	—	29.6-31.5
anal origin	—	33.3	—	35.2-37.9
ventral bases	—	25.7	—	24.7-28.4
Least depth of caudal peduncle	—	2.08	—	1.3-1.9
Dorsal base	—	5.55	—	*ca.* 5.7-6.8
Anal base	—	64.0	—	60.0-*ca.* 61.5

Table 5.

Counts and measurements of *Gonostoma atlanticum*.

	Combat specimen South Carolina	U.S.N.M. 44582 Florida	SIO 56-133 Marshall Ids.	
Standard length	63.5	53	55	46
Dorsal rays	18	16	17	17
Anal rays	30	*ca.* 29	28	28
Pectoral rays	10	—	11	10?
Ventral rays	6?	—	7	—
Branchiostegal rays	11	11	11	11
Gill rakers on first arch	11+6	11+6	11+5	11+6
Vertebrae	—	38	—	—
BR	9	9	9	9
IV	15	16	16	16
VAV	5	5	5	5
AC	19	19	17+[1]	19
IC	39	40	—	40
OA	—	—[2]	—	13
	Per cent of standard length			
Depth	15.75	*ca.* 16.0[3]	*ca.* 16.3	*ca.* 16.3
Head	*ca.* 23.6	*ca.* 24.5	*ca.* 25.5	27.2
Snout	3.94	3.77	3.64-4.54	*ca.* 4.34
Orbit	*ca.* 3.94	3.77	4.54	4.34-5.43
Interorbital width at center of eye	3.94	3.77	4.54	3.26-4.34
Upper jaw	18.9	18.8	20.0	20.6
Premaxillary	3.94	3.77	4.54	4.34
Toothed portion of maxillary	15.0	15.1	15.4	16.3
Tip of snout to:				
dorsal origin	58.3	59.4	59.0	*ca.* 56.5
anal origin	58.3	57.5	56.5	*ca.* 55.4
ventral bases	*ca.* 48.8	47.1	*ca.* 47.2	*ca.* 46.7
Distance between:				
anal origin and caudal base	42.5	41.5	41.0	42.4
last anal ray and caudal base	9.45-10.0	11.3	*ca.* 10.0	9.77
last dorsal ray and caudal base	23.6	24.5	23.6	23.9
inner insertion of ventral base and anal origin	*ca.* 9.45	9.43	*ca.* 6.36	*ca.* 7.6
Least depth of caudal peduncle	6.3	5.65	6.36	5.43-6.5
Dorsal base	18.1-18.9	*ca.* 17.9	16.3-17.3	18.45
Anal base	33.1	31.1	*ca.* 29.8	*ca.* 32.6

[1]Lacking on end of tail.

[2]Unpublished drawing of this specimen, prepared in June, 1886, shows 13.

[3]Depth somewhat greater in drawing.